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Abstract

Merger negotiations routinely occur amidst economically significant a target stock price runups. Since the source of the runup is unobservable (is it a target stand-alone value change and/or deal anticipation?), feeding the runup back into the offer price risks "paying twice" for the target shares. We present a novel structural empirical analysis of this runup feedback hypothesis. We show that rational deal anticipation implies a nonlinear relationship between the runup and the offer price markup (offer price minus runup). Our large-sample tests confirm the existence of this nonlinearity and reject the feedback hypothesis for the portion of the runup not driven by the market return over the runup period. Also, rational bidding implies that bidder takeover gains are increasing in *target* runups, which our evidence supports. Bidder toehold acquisitions in the runup period are shown to fuel target runups, but lower rather than raise offer premiums. We conclude that the parties to merger negotiations interpret market-adjusted target runups as reflecting deal anticipation.

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1 Introduction

There is growing interest in the existence of informational feedback loops in financial markets. A feedback loop exists if economic agents take corrective actions based on information inferred from security prices. We analyze this phenomenon in the rich context of merger negotiations and takeover bidding. Our setting is one where a bidder is in the process of finalizing merger negotiations, and where the target management demands an increase in the planned offer price to reflect a recent runup in the target's stock price. The target argues that the runup reflects an increase in its market value as a *stand-alone* entity (i.e. without a control-change) and therefore justifies correcting the already planned offer.

The problem for the bidder is that the runup may alternatively reflect rumor-induced market anticipation of the pending deal, and so a markup of the bid risks "paying twice". After all, takeover bids are frequently preceded by media speculations, occasionally fueled by disclosures of large open market purchases of target shares (toeholds). Also, there is large-sample evidence that target runups tend to be reversed absent a subsequent control change—when all bids fail and the target remains independent (Betton, Eckbo, and Thorburn, 2009). This reversal is inconsistent with runups representing increase in target stand-alone values. Last, but not the least, bidders should be weary of target incentives to overstate the case for offer price markups regardless of its true source.

Absent a clearly identifiable source for the runup, a rational (Bayesian) response may be to assign some positive probability to both the deal anticipation and stand-alone scenarios. For example, since general market movements during the negotiations may cause changes in the target's stand-alone value, it may be reasonable to expect some impact of runups on bid premiums. However, the issue is complex, as there are a number of alternative bid strategies. For example, bidders may choose to ignore the runup initially, leaving it to competing bidders to "prove" undervaluation, and walk away if the final premium becomes too high. More complex bidding strategies emerge if one assumes that the market is better informed than the bidder (Bond, Goldstein, and Prescott, 2010), or if the seller reserve price is stochastic (Khoroshilov and Dodonova, 2007). The latter is reminiscent of our context where merger negotiations are linked to the information content of the target stock price runup.

We pose the following type of questions: Do takeover rumors which cause target stock price runups feed back into higher offer prices? What are testable implications of a scenario where the bidder "pays twice" by transferring the runup to the target in the absence of changes in the target stand-alone value during the runup period? Do toehold purchases in the runup period fuel runups and make the takeover more costly for the bidder?

To address these issues, we use a rational economic bidding model which permits takeover rumors to simultaneously affect the probability of a bid and the expected value of the offer conditional on a bid being made. We begin by proving that the relationship between runups and offer price markups is highly nonlinear under deal anticipation. Moreover, the model implies that bidder takeover gains are increasing in the *target* runups. These pricing implications have been overlooked by previous empirical research on takeovers, and they reverse an influential conclusion by Schwert (1996) that target runups tend to lead to costly offer markups.

We also prove that with rational bidding, feeding the runup back into the offer price implies a *positive* relationship between runups and offer price markups. The intuition is that, as synergy signals improve (causing larger runups), bidder deal benefits increase faster than the deal probability declines. Our evidence rejects this implication of the feedback hypothesis as the projection of markups on runups yields a significantly negative slope. Bids do, however, appear to be corrected for the portion of the target runup which is driven by the (exogenous) market return over the runup period. Since a correction for the market return does not alter the sharing of synergy gains, it does not make the takeover more expensive for the bidder.

Finally, we present evidence on the effect of bidder open-market purchases of target shares (toeholds) during the runup period (short-term toeholds). Short-term toehold purchases are interesting in our context because they may create takeover rumors and fuel target runups. We find that runups are in fact greater for takeovers with toehold acquisitions in the runup period. Nevertheless, as reported previously (Betton and Eckbo, 2000; Betton, Eckbo, and Thorburn, 2009), toeholds reduce rather than increase offer premiums, possible because toeholds improve the bidder's bargaining position (Bulow, Huang, and Klemperer, 1999). We find no evidence that toeholds acquired during the runup period increase the cost of the takeover.[1]

[1]While not pursued here, our lack of evidence of a feedback loop from (conditional) target runups to offer prices suggests also that *expected* (unconditional) runups have little if any impact on the expected value of bidding so long as producing synergy gains also requires unique bidder resources. For an empirical analysis of ex ante effects of market

The rest of the paper is organized as follows. Section 2 lays out the dynamics of runups and markups as a function of the information arrival process surrounding takeover events, and it discusses predictions of the deal anticipation hypothesis. Section 3 performs our empirical analysis of the projections of markups on runups based on the theoretical structure from Section 2. Section 4 shifts the focus to the relationship between target runups and bidder takeover gains, developing both theory and tests. Section 5 examines toehold purchases in the runup period, while Section 6 concludes the paper.

2 Projections of markups on runups: Theory

This section analyzes the information arrival process around takeovers, and how the information in principle affects offer prices and, possibly, feeds back into offer price corrections. It is instructive to begin by providing a sense of the economic importance of the target runup in our data. Figure 1 illustrates the takeover process which begins with the market receiving a rumor of a pending takeover bid, resulting in a runup V_R of the target stock price. In our vernacular, V_R is the market feedback to the negotiating parties prior to finalizing the offer price. Since the exact date of the rumor is largely unobservable, V_R is measured over a *runup period* which we in our empirical analysis take to be the two calendar months prior to the first public bid announcement. Figure 1 shows an average target abnormal (market risk adjusted) stock return of about 10% when cumulated from day -42 through day -2.[2]

In the theory below, we define the expected offer price markup as $V_P - V_R$, where V_P denotes the expected final offer premium. In Figure 1, this is shown as the target revaluation over the three-day announcement period (day -1 through day +1). The initial offer announcement does not fully resolve all uncertainty about the outcome of the takeover (it may be followed by a competing offer or otherwise rejected by target shareholders), and so V_P is the expected final offer premium conditional on a bid having been made. The average two-day target announcement return is about 25% in the full sample of takeovers.

The challenge for the negotiating parties is to interpret the information in this runup: does it justify correcting (marking up) the already planned bid? In some cases, the runup may reflect a

feedback loops, see Edmans, Goldstein, and Jiang (2009).

[2]Our sample selection procedure is explained in section 3.1 below.

known change in stand-alone value which naturally flows through to the target in the form of a higher offer premium. In other cases, the target management may have succeeded in arguing that the runup is driven by stand-alone value changes when it is not (and so feeding the runup back into the offer price amounts to "paying twice"). The point of our analysis is not to rationalize a specific bargaining outcome but to derive testable implications for the relationship between runups, markups, and bidder returns.

We begin by analyzing the case where the negotiating parties agree that the target runup is driven by deal anticipation only. This is followed by the presence of a known target stand-alone value change in the runup period. Finally, the analysis covers the feedback hypothesis where the offer price is marked up with the target runup even in the absence of a target stand-alone value change.

2.1 Pricing implications of deal anticipation

Suppose the market receives a signal s which partially reveals the potential for synergy gains S from a takeover. S is known to the bidder and the target, while the market only knows the distribution over S given the signal. The bid process involves a known sharing rule for how the synergy gains will be split between target and bidder, and a known bidding cost C. Depending on the sharing rule for the synergy gains and bidding costs, there exists a threshold, K, in S above which the benefit to the bidder of making a bid is positive. $B(S,C)$ denotes the benefit to the target of takeover, i.e., its portion of the total synergy gains S net of the target's portion of the bidding cost C. We assume that $B(S,C) = 0$ if no bid takes place (which occurs when $S < K$).

For simplicity, the target's stock price and the market's takeover probability $\pi(s)$ are both normalized to zero prior to receiving takeover rumors s. The signal s causes the market to form a posterior distribution over synergy gains S and to update the takeover probability $\pi(s)$ accordingly. Both effects contribute to a revaluation of the market price of the target. The revaluation (runup) equals the expected value of the bid conditional on s:

$$V_R = \pi(s)E_s[B(S,C)|s, bid] = \int_K^\infty B(S,C)g(S|s)dS, \tag{1}$$

where $g(S|s)$ is the market's posterior density of S given s.

At the moment of the first bid announcement, but not necessarily knowing precisely what the final bid will be (or whether it will be accepted by the target shareholders), the expected final bid premium is

$$V_P = E[B(S,C)|\ bid] = \frac{1}{\pi(s)} \int_K^{\infty} B(S,C) g(S|s) dS. \tag{2}$$

The *actual* bid premium should equal V_P plus uncorrelated noise.

The expected markup, $V_P - V_R$, is the remaining surprise that a bid takes place times the expected value of the bid and, when combined with equation (1), can be written as

$$V_P - V_R = \frac{1-\pi(s)}{\pi(s)} V_R. \tag{3}$$

The valuations in equations (1)–(3) provide the basis for our analysis of how runups and markups relate under deal anticipation. Equation (3) is a general implication of market rationality. It holds whether the target stand-alone value changes during the runup period, whether the bargaining outcome is for the bidder to transfer the runup to the target, and whether the bidder rationally adjusts the bid threshold K to the specific bargaining outcome. While the theory below illustrates specific examples of this general form, our empirical analysis works with the general form and (as discussed below) is therefore robust.

We use equation (3) to study empirically the behavior of the intercept and the slope coefficient in cross-sectional projections of the markup on the runup. Proposition 1 summarizes key properties of this projection:

Proposition 1 (deal anticipation): *With deal anticipation, the projection of $V_P - V_R$ on V_R is nonlinear in the signal s. Moreover, the degree of non-linearity depends on the sharing of synergy gains, net of bidding costs, between the bidder and the target.*

Proof: We show the proof for the simple case where K is fixed and known, the sharing rule for the net synergy gains between the bidder and the target is known, and the distribution of s around S is such that the posterior distribution of S given s is uniform: $S|s \sim U(s-\Delta,\ s+\Delta)$. Let θ denote the portion of S kept by the bidder, and let γ be the portion of the bidding cost C borne by the bidder (so $K = \frac{\gamma C}{\theta}$). The valuation equations for the target are, respectively:[3]

$$V_P = \frac{1}{2}[(1-\theta)(s+\Delta) - (1-\gamma)C] \quad \text{and} \quad V_R = \frac{s+\Delta-\frac{\gamma C}{\theta}}{2\Delta}V_P. \tag{4}$$

The first derivatives with respect to s are

$$\frac{\partial V_P}{\partial s} = \frac{1-\theta}{2} \quad \text{and} \quad \frac{\partial V_R}{\partial s} = \frac{(1-\theta)(s+\Delta)-(1-\gamma)C}{2\Delta}. \tag{5}$$

Over the range where the bid is uncertain (when S given s is below $K = \frac{\gamma C}{\theta}$), the ratio of the derivative of the expected markup divided by the derivative of the runup is

$$\frac{\partial[V_P - V_R]}{\partial V_R} = \frac{-(1-\theta)s + (1-\gamma)C}{(1-\theta)(s+\Delta)-(1-\gamma)C}. \tag{6}$$

Since the ratio in equation (6) is a function of s, the relation between expected markup and runup does not have a constant slope. Moreover, the ratio also contains the parameters θ, γ and C, all of which determine the sharing of synergies net of bidding costs. ■

Figure 2 illustrates the relation between V_P, $V_P - V_R$ and V_R for the uniform case where $\theta = 0.5$, $\gamma = 1$, and the bid costs C are relatively low relative to the uncertainty Δ in S. In Panel A of Figure 2, the horizontal axis is the synergy signal s which drives the conditional bid probability $\pi(s)$ and the target runup. The runup function has several features. First, at very low bid probabilities, the runup is near zero, but, if a bid takes place, the markup has a positive intercept. This is because when the bidder is just indifferent to a bid ($\theta S = \gamma C$), the target still receives a positive net benefit. Second, as the bid probability increases, the runup increases in a convex fashion as it approaches V_P. Both the deal probability and the expected bid premium, given that a bid takes place, are moving in the same direction with s.

Turning to the expected markup, $V_P - V_R$, when the bid probability moves above zero on the

[3] With the uniform distribution, the density $g(S|s)$ is a constant, $g(S|s) = \frac{1}{s+\Delta-(s-\Delta)} = \frac{1}{2\Delta}$. Moreover, the takeover probability $\pi(s) = Prob[s \geq K] = \frac{s+\Delta-K}{2\Delta}$. Since the actual bid is $B(S,C) = (1-\theta)S - (1-\gamma)C$, the expected bid is

$$V_P = \frac{1}{\pi(s)}\int_K^{s+\Delta} B(S,C)g(S|s)dS = \frac{2\Delta}{s+\Delta-K}\int_K^{s+\Delta}[(1-\theta)S-(1-\gamma)C]\frac{1}{2\Delta}dS = \frac{1-\theta}{2}(s+\Delta+K)-(1-\gamma)C.$$

Noting that $K = \frac{\gamma C}{\theta}$ yields the expression for V_P in equation (4). Moreover, the expression for V_R is $V_R = \pi(s)V_P$.

low range of s, the impact of s is initially positive because the negative impact on the surprise that a bid takes place is less important than the improvement in expected bid quality S. However, after a point, the expected markup begins to fall as the surprise declines faster than expected deal quality improves. At extremely high s, the bid is almost perfectly anticipated and the expected markup approaches zero. There is a point in s above which the bid is certain to take place ($\pi(s) = 1$) because the range of S given s is entirely above $K = \frac{\gamma C}{\theta}$. Above this point the expected markup inflects and becomes zero.

To see the implication for the coefficient in a projection of the markup on the runup, Panel B of Figure 2 transforms the x axis from $\pi(s)$ in Panel A to V_R.[4] Several aspects of the relations now show clearly. First, in this example of benefit sharing and bid costs, the relation between the runup and the expected markup is generally non-monotonic. The ratio of derivatives shows that the sharing rule as well as the relation between bid costs and uncertainty about the synergy gains influence the slope of the function. For the example in Panel A of Figure 2, Panel B shows a highly concave projection of $V_P - V_R$ onto V_R.

Armed with the benefit function, and cost magnitude relative to the uncertainty in S, it is possible to create a range of relations between expected markup and runup. If, for example, the sharing of synergy gains and costs are equal ($\theta = \gamma$), the expected markup starts at zero and proceeds through a concave curve back to zero, both when shown against bid probability and runup. On the other hand, if the uncertainty in S is relatively low in comparison to bid costs ($\Delta < C$), and the bidder bears all of the costs ($\gamma = 1$), the expected markup can start at a high intercept and progress negatively to zero.[5]

A number of papers in the takeover literature presents *linear* projections of markups on runups.[6] The conventional intuition runs something like the following: deal anticipation in the runup will reduce the offer price markup dollar for dollar to avoid "paying twice". Thus, a linear projection of the markup on the runup should produce a coefficient of minus one. Again, this intuition ignores

[4]The transformation is possible because V_R is monotonic in s and thus has an inverse. To achieve the projection, the inverse function $(V_P(s)^{-1})$ is inserted into $V_P - V_R$ on the vertical axis.

[5]Figure 2 changes only slightly if we preserve all of the assumptions in the previous example except to allow the posterior distribution of S given s to be normally distributed with the same standard deviation $(\Delta/\sqrt{3})$. The only notable difference in the relations is that the right tail of the expected markup and its projection on the runup has a gradual inflection that creates a convexity for highly probable deals even before these deals are certain to take place. The right tail then progresses towards zero, although no deal is certain with a normally distributed posterior.

[6]See Betton, Eckbo, and Thorburn (2008a) for a review.

the joint impact of the signal s on the takeover probability and the expected synergies in the deal (Proposition 1). As summarized in Lemma 1, under the deal anticipation hypothesis, the slope coefficient in such a linear projection has a much wider range than conventionally thought:

Lemma 1 (linear projection): *With deal anticipation, and as long as the takeover probability π is a function of the synergy gains S, a linear projection of $V_P - V_R$ on V_R yields a slope coefficient that is strictly greater than -1, and the coefficient need not be different from zero.*

Proof: See Appendix A.

Because the coefficient $\frac{1-\pi(s)}{\pi(s)}$, in equation (3) is nonnegative, finding a negative linear slope immediately rejects linearity but *not* deal anticipation (Proposition 1). Notice also that, because of the nonlinearity between runups and markups, switching the dependent variable from the markup to the offer premium in the projection on runup changes the form of the right-hand side (to involve the takeover probability $\pi(s)$). This invalidates also the inference in the extant literature concerning the deal anticipation hypotheses from regression of the offer premium on V_R. This inference has been that the slope in this linear projection should have a coefficient of zero (to capture the intuition that the offer premium does not respond to the runup). Again, this inference is incorrect as it fails to account for the impact of the cross-sectional variation in the offer probability $\pi(s)$.

2.2 Adding a target stand-alone value change.

The model in equation (1) abstracts from information which causes revisions in the target's stand-alone value during the runup period. Let T denote this stand-alone value change and assume that T is exogenous to the pending takeover and that it does not impact the bidder's estimate of the synergy gains S (which is driving the takeover process). As a result, T does not affect the probability of a bid.[7] Moreover, whatever the source of T, assume in this section that both the bidder and the target agree on its value.[8] This means that the negotiating parties will allow the

[7]The cost of extending a bid might be related to the target size so changes in stand-alone value might impact C and therefore $\pi(s)$ indirectly. We do not consider this issue here.

[8]The agreement may be viewed as a bargaining outcome after the target has made its case for marking up the premium with its own estimate of T. Given the target's incentives to overstate the case for T, the bargaining outcome may well be tied to certain observable factors such as market- and industry-wide factors, which the bidder may find acceptable. We present some evidence consistent with this below.

full value of T to flow through to the target through a markup of the offer price.

Since T accrues to the target whether or not it receives a bid, if a bid is made, the bid premium will be $B(S, C) + T$ and the runup becomes

$$V_{RT} = \pi(s)E_s[B(S, C) + T|s, bid] + [1 - \pi(s)]T = V_R + T. \tag{7}$$

Subtracting T on both sides yields the *net runup*, $V_{RT} - T$, which is the portion of the runup related to takeover synergies only. Once a bid is made, it is marked up by the stand-alone value increase:

$$V_{PT} = E_s[B(S, C) + T|s, bid] = V_P + T, \tag{8}$$

where the portion $V_{PT} - T$ of the bid again relates to the synergy gains only.

Moreover, since both V_{RT} and V_{PT} include T, the effect of T nets out in the markup $V_{PT} - V_{RT}$ which remains unchanged from section 2.1. However, the projection now uses the net runup on the right-hand side:

$$V_{PT} - V_{RT} = \frac{1 - \pi(s)}{\pi(s)}[V_{RT} - T], \tag{9}$$

which also contains the nonlinearity. Eq. (9) implies that if the markup is projected on V_{RT} with no adjustment for T, the variation in runups across a sample due to changes in stand-alone values will appear as noise unrelated to the markup. The effect is to attenuate the nonlinear impact of the synergy signal s on the relation between the runup and the markup:

Proposition 2 (stand-alone value change): *Adding a known stand-alone value change T to the target runup, where T is independent of S, lowers the slope coefficient in a projection of markup on runup towards zero. A slope coefficient less than zero, or the projection being nonlinear, implies that a portion of the runup is driven by deal anticipation and substituting for the markup.*

Proof: We again illustrate the proof for the uniform case. The valuation equations for the target are now:

$$V_{PT} = \frac{1-\theta}{2}(s + \Delta + \frac{\gamma C}{\theta}) - (1-\gamma)C + T \quad \text{and} \quad V_{RT} = \frac{s + \Delta - \frac{\gamma C}{\theta}}{2\Delta}V_P, \tag{10}$$

where V_P as before is the expected bid premium with zero change in the target's stand-alone value (as in eq. (2)). Using these valuation equations, Figure 3 illustrates how a sample of data might look if it contains independent variation in both s and T. Behind Figure 3 is a set of six subsamples of data, each subsample containing a different T. Within each subsample, the data contains observations covering continuous variation in s. Across subsamples, the expected markup function shifts right as T increases. The dotted and dashed lines in the figure show the relation between expected markup and runup when T is zero and at its maximum across subsamples. The solid line shows the vertical average across the six subsamples for each feasible V_{RT}. The addition of variation in T moderates the relation observed in any subsample that holds T constant. However, there is still a concavity in the relation between average markup $V_P - V_R$ and V_{RT}.[9] ■

Rearranging eq. (9) provides a link to earlier work such as Schwert (1996) who regresses the offer premium on the runup:

$$V_{PT} = \frac{1}{\pi(s)}[V_{RT} - T] + T. \tag{11}$$

Therefore, in a rational market with both deal anticipation and a known change in stand-alone value, the offer premium should relate in a non-linear way to the net runup and one-for-one with surrogates for changes in stand-alone value. Moreover, the net runup should be unrelated to surrogates for changes in stand-alone value, so the one-for-one relation between premiums and surrogates for T holds in a univariate regression setting.

2.3 Feeding the runup back into the offer price

We now examine the case where bids are corrected for the full target runup V_R even in the absence of a change in the target's stand-alone value. Marking up the offer price when the runup is caused by deal anticipation amounts to a pure transfer from the bidder to the target. A decision by the bidder to mark up the planned offer with V_R may be the outcome of a bargaining process where neither party knows how to interpret the runup, or where the target management succeeds in convincing the bidder that the runup is driven by stand-alone value changes. The point here is not to rationalize such an outcome, but to show that the market pricing process still converges to a point where takeover bids may take place. We then derive the implied relationship between

[9] For a benefit function that has the bidder paying all of the bid costs, the relation is monotonic downward sloping, although with an attenuated slope.

markups and runups as before.

Casual intuition would suggest that a transfer by the bidder of the runup to the target would serve to raise bids by the amount of the runup, thus breaking the earlier connection between markup and runup.[10] However, this intuition again fails to account for the role of changing deal probabilities across the sample.

Suppose that bidders offer bids according to the same selection criteria as before, with the threshold for total synergy gains unaffected. If we add the runup to equation (1) and thus π times the runup to equation (2), we see that the expression in equation (3) is unaffected. In this case, of course, the bidder will bid on some deals where, after the transfer of synergy gains to the target, the bidder pays too much, breaking the positive connection between bidder and target gains at high levels of the signal. It is also possible to show that the nonlinear relation of equation (3) is monotonic positive although still nonlinear. This is because the runup accelerates in the signal and the affect of prior anticipation never outweighs the benefits.[11]

A second bidding model reinforces these effects. Suppose the bidder transfers the runup to the target if a bid is made, but the bidder only offers bids when synergy gains are sufficient for the bidder to benefit from a bid even after transferring the runup. In this case the bidding threshold K increases in the runup (it becomes $K^* = \frac{\gamma C + V_R}{\theta}$), and the deal probability becomes a decreasing function of the runup.[12] This process also converges to the same expression as equation (3), except the probability is now lower for any signal. Tracing through the model implications shows that the markup is again nonlinear but a positive function of the runup. The intuition behind the positive relation is that with full transfer of runups, the deal benefits increase faster than the deal probability declines as signals improve.[13]

The hypothesis that the full runup is transferred to the target is thus rejected by a negative

[10]For example, Schwert (1996) projects the markup on the runup and predicts a slope coefficient of zero under the hypothesis that the offer is marked up with the full runup ("markup pricing"). He fails to reject a slope coefficient of zero for his sample of takeovers.

[11]Proof of this is available from the authors.

[12]The runup now becomes a function of itself:

$$V_R^* = \pi^*(s, V_R) E_s[B(S,C)|s, bid] + V_R,$$

where K^* is the lower limit of integration for both $\pi^*(s, V_R)$ and $E_s[B(C,S)]$.

[13]Observed bids after large runups must correspond with sufficiently high total synergy gains for bidders to find it profitable to make offers. Since it remains uncertain whether bidders will meet this condition even if the synergy signal s is large, the markup continues to capture a surprise element that is increasing in both the signal and the endogenous runup.

slope of markup on runup:

Proposition 3 (target wealth transfer): *The hypothesis that runups caused by deal anticipation are transferred from bidders to targets is rejected by a negative or no average relation between markups and runups.*

We illustrate Proposition 3 by the example in Figure 4 for the uniform case, with $\theta = 0.5$, $\gamma = 1$, $C = 1$, and $\Delta = 4$ (T is ignored in this example). The solid lines in Figure 4A show the original relation (with no transfer of runup) between the signal s and the expected value of a bid if one is made, V_P, the runup V_R and the markup $V_P - V_R$. The dashed lines in Figure 4B show the same valuation concepts when V_R is transferred to the target from the bidder if a bid is made. The projection of the markup on the runup is clearly *positive* and monotonic over the entire range of s. What is also striking about the dashed relations is that the markup converges to a one for one co-movement with the runup once the probability $\pi^*(s, V_R)$ rises beyond a point of about 0.2 in this example. ■

It is also interesting that, in Figure 4, $\pi^*(s, V_R)$ never exceeds 0.5 over the entire range of s shown in the graph. This is very different from the behavior of $\pi(s)$ which reaches unity at a relatively low level of s ($s = 6$). At $s = 6$, the takeover probability with markup of the full runup is $\pi^*(s, V_R) = 0.37$.

3 Empirical projections of markups on runups

3.1 Sample characteristics

As summarized in Table 1, we sample control bids from SDC using transaction form "merger" or "acquisition of majority interest", requiring the target to be publicly traded and U.S. domiciled. The sample period is 1/1980-12/2008. In a control bid, the buyer owns less than 50% of the target shares prior to the bid and seeks to own at least 50% of the target equity.

As in Betton, Eckbo, and Thorburn (2009), the bids are grouped into takeover contests. A takeover contest may have multiple bidders, several bid revisions by a single bidder or a single control bid. The initial control bid is the first control bid for the target in six month. All control bids announced within six months of an earlier control bid belong to the same contest. The contest ends when there are no new control bids for the target over a six-month period. This definition results in 13,893 takeover contests. We then require targets to (1) be listed on NYSE, AMEX, or NASDAQ; and have (2) at least 100 days of common stock return data in CRSP over the estimation period (day -297 through day -43);(3) a total market equity capitalization exceeding $10 million on day -42; (4) a stock price exceeding $1 on day -42; (5) an offer price in SDC; (6) a stock price in CRSP on day -2; (7) an announcement return for the window [-1,+1]; (8) information on the outcome and ending date of the contest; and (9) a contest length no longer than 252 trading days (one year). The final sample has 6,150 control contests.

Approximately three-quarters of the control bids are merger offers and 10% are followed by a bid revision or competing offer from a rival bidder. The frequency of tender offers and multiple-bid contests is higher in the first half of the sample period. The initial bidder wins control of the target in two-thirds of the contests, with a higher success probability towards the end of the sample period. One-fifth of the control bids are horizontal. A bid is horizontal if the target and acquirer has the same 4-digit SIC code in CRSP or, when the acquirer is private, the same 4-digit SIC code in SDC.[14]

Table 2 shows average premiums, markups, and runups, both annually and for the total sample. The initial offer premium is $\frac{OP}{P_{-42}} - 1$, where OP is the initial offer price and P_{-42} is the target stock closing price or, if missing, the bid/ask average on day -42, adjusted for splits and dividends. The bid is announced on day 0. Offer prices are from SDC. The offer premium averages 45% for the total sample, with a median of 38%. Offer premiums were highest in the 1980s when the frequency of tender offers and hostile bids was also greater, and lowest after 2003. The next two columns show the initial offer markup, $\frac{OP}{P_{-2}} - 1$, which is the ratio of the offer price to the target stock price on day -2. The markup is 33% for the average control bid (median 27%).

The target runup, defined as $\frac{P_{-2}}{P_{-42}} - 1$, averages 10% for the total sample (median 7%), which is roughly one quarter of the offer premium. While not shown in the table, average runups vary considerably across offer categories, with the highest runup for tender offers and the lowest in bids that subsequently fail. The latter is interesting because it indicates that runups reflect the

[14]Based on the major four-digit SIC code of the target, approximately one-third of the sample targets are in manufacturing industries, one-quarter are in the financial industry, and one quarter are service companies. The remaining targets are spread over natural resources, trade and other industries.

probability of bid success, as expected under the deal anticipation hypothesis. The last two columns of Table 2 show the net runup, defined as the runup net of the average market runup ($\frac{M_{-2}}{M_{-42}} - 1$, where M is the value of the equal-weighted market portfolio). The net runup is 8% on average, with a median of 5%.

3.2 Is the projection nonlinear?

Propositions 1 and 2 above, as summarized in empirical hypothesis H1 and figure 2, prove that the relation between markups and runups will be nonlinear when the runup is driven by market anticipation of the expected takeover premium. To test for this nonlinearity, we proceed as follows. Suppose one were to estimate a linear projection of markups on runups, superimposed on the true nonlinear projection for, say, the case of uniformly distributed errors in the synergy signal in Figure 5. Now, if we order the data by runup in the cross-section, the residuals from the linear projection should show a discernable pattern: moving from the left in Figure 2 (i.e., starting with low runups), the residuals should become less negative, then increasingly positive. At a point, the residuals should become less positive, move negative, then cycle around again.

This pattern will generate weak serial correlation in the residuals. Without any nonlinearity, the residuals should be serially uncorrelated because the deals, when ranked on runup have nothing to do with one another. Serial correlation should exist regardless of whether or not there is an upward sloping portion of the nonlinear projection of expected markup on runup. It should exist within any region of the data that creates meaningful nonlinearity in the expected markup. The idea that patterns in residuals are a specification test follows simply from the logic that the sum of residuals from a correctly specified model having normally distributed errors should form a discrete Brownian Bridge from zero to zero regardless of how the independent variables are ordered.[15]

To test for this serial correlation in residuals, we begin with the first linear regression specification in Table 3. In projection specification (1), the markup and the runup are defined using the offer price and the total target return in the runup period. The linear projection has an intercept of 0.36 and a slope of -.24. Next, we order the data by runup and the calculate the residuals from this projection. The first-order serial correlation coefficient for the residuals sorted this way is 0.030

[15]A Brownian Bridge is a random walk process cumulating between known points, e.g., random residuals starting at zero and summing to zero across a sample of data. Cumulative residuals in an OLS regression with normally distributed errors are, by construction, a Brownian Bridge.

with a statistically significant t-ratio of 2.36. This positive serial correlation rejects linearity.[16]

A rejection of linearity, however, does not clarify the nature of the rejection. The form of the non-linearity might be at odds with the theoretical prediction of a general concave then convex shape shown in Figure 2. We therefore fit a flexible functional form to the data patterned after the beta distribution, denoted $\Lambda(v, w)$ where v and w are shape parameters. The beta density is convenient because it is linear downward sloping when the shape parameters are $v = 1$ and $w = 2$. For other shape parameters the density can be concave, convex, peaked at the left, right or both tails or unimodal with the hump toward the right or left. Our model in Section 2.1 suggests a unimodal fit with the hump to the left and the right tail convex and falling to zero as deals become increasingly certain.

Applying the beta density to the markup data, write

$$Markup = \alpha + \beta[(r - min)^{(v-1)}(max - r)^{w-1}/\Lambda(v, w)(max - min)^{v+w-1}] + \epsilon, \qquad (12)$$

where r is the runup, max and min are respectively the maximum and minimum runups in the data, α is an overall intercept, and β is a scale parameter, and ϵ is a residual error term. If the parameters v and w are set respectively to 1 and 2, a least squares fit of the markup to the runup (allowing α and β to vary) will produce an α and β that replicate a simple linear regression. The intercept and slope need to be translated because v and w impose a particular slope and intercept on the data, which α and β modify. A least squares fit over all four parameters allows the data to find a best non-linear shape within the constraints of the flexibility allowed by the beta density. As suggested, this density is quite flexible.

Continuing with projection (1) in Table 3, the nonlinear estimation reduces the residual serial correlation from 0.030 with the best linear form to 0.015 with the best nonlinear form. since the latter has a t-statistic of only 1.15, this shows that the nonlinear fit eliminates the statistically significant serial correlation from the linear fit. This is consistent with the deal anticipation hypothesis for the runup (Proposition 1 and Lemma 1).

Panel A of Figure 5 shows both the linear and best nonlinear fit of the markup on the runup corresponding to projection (1) in Table 3. The graph displays the fitted curves along with the

[16]With 6,000+ observations, it is safe to ignore the slightly negative correlation caused in random linear data by the constraint that the residuals must sum to zero.

data cloud. Obviously, the data are quite noisy since the fits explains only about 3 to 6 percent of the variation. Still, the figure is strikingly similar to the theoretical shape in Figure 2. We conclude that the data are strongly supportive of the nonlinearity that prior anticipation creates. The negative slope coefficient in the projection also rejects the hypothesis that the bidder transfers to the target a runup driven by deal anticipation (Proposition 3).

The model underlying equation (9) motivate subtracting a control for changes in stand-alone value T from the runup. Possible controls would be the cumulative market return, a CAPM benchmark or an industry adjustment. All of these are subject to their own varying degrees of measurement error. Since any adding back of stand-alone value changes would have to be agreed upon by both the target and the bidder, simpler is probably better.

While not reported formally, we find that nonlinearity is enhanced by subtracting from the runup a market-model alpha measured over the year prior to the runup. This is consistent with recent negative target performance indicating synergy benefits to the takeover (e.g. inefficient management), and thus factoring this into premiums offered by bidders. We also find that bid premiums are significantly negatively correlated with prior market model alphas, further supporting this line of thinking. Consistent with this, in Table 8 below, we report strong evidence that offer premiums vary almost one-to-one with the market return over the runup period: the coefficient estimate on the variable $Market\ runup$ shown in the last column of Table 8 is a highly significant 0.93.

The result of projection (1) in Table 3, combined with the finding that offer premiums move closely with the market runup, gives strong support to the hypothesis that the true process between markups and runups in the data follows equation (9) in Section 2.

We provide further evidence on the deal anticipation hypothesis using bidder returns in Section 4 below. However, we first turn to a number of robustness checks on the above conclusion using the remaining projections in Table 3. While not shown here, for all of these projections, the resulting form of the non-linearity corresponds closely to that shown in Figure 5 for projection (1), and are thus consistent with the general concave then convex shape shown in the theoretical Figure 2.

3.3 Robustness checks

3.3.1 The probability of contest success

As defined earlier, the theoretical premium variable V_P is the expected premium conditional on the initial bid. Some bids fail, in which case the target receives zero premium. Presumably, the market reaction to the bid adjusts for an estimate of the probability of an ultimate control change. This is apparent from Figure 1 where the target stock price on average runs up to just below 30% while the average offer premium in Table 2 is 45%.

The standard approach to adjust for the probability of success is to cumulate abnormal stock returns over a period after the first bid thought to capture the final contest outcome.[17] However, long windows of cumulation introduces a substantial measurement error in the parameters of the return generating process. Moreover, cross-sectionally fixed windows introduces error in terms of hitting the actual outcome date. One could tailor the event window to the outcome date for each target, however, outcome dates are not always available to the researcher.

Our approach is instead to use the initial offer price (which is known) and to adjust this offer for an estimate of the target success probability (where target failure means that no bidder wins the contest). We do this in two ways. The first is to restrict the sample to those targets which we know succeeded (ex post). This is the sample of 5,035 targets used in projection (2) in Table 3 (so the unconditional sample success probability is 5,035/6,150=0.82). This projection also shows significant linear residual serial correlation followed by a substantial reduction of this correlation when using the nonlinear form. Notice that the nonlinear residual correlation remains significantly different from zero, which means that the nonlinear form is not now able to remove completely the serial correlation in the data. However, the hypothesis that the true projection is nonlinear cannot be rejected.

The second adjustment for the probability of target success uses much more of the information in the sample. It begins by estimating the probability of contest success using probit. The results of the probit estimation is shown in columns 1 and 2 of Table 4. The dependent variable takes on a value of one if the target is ultimately acquired either by the initial bidder or a rival bidder, and zero otherwise. The explanatory variables are defined in Table 5. For expositional purposes, the

[17] For example, Schwert (1996) use a window of cumulation through 126 trading days following the bid date.

variables are classified into target, bidder and contest characteristics.

The probit regressions for contest success are significant with an pseudo-R^2 of 21%-22%. The difference between the first and the second column is that the latter includes two dummy variables for the 1990s and the 2000s, respectively.[18] As shown earlier by Betton, Eckbo, and Thorburn (2009), the probability that the takeover is successful increases with the size of the target (log of target equity market capitalization), and is higher for public acquirers and in horizontal transactions. Bids for targets traded on NYSE or Amex, targets with a relatively high stock turnover (average daily trading volume, defined as the ratio of the number of shares traded and the number of shares outstanding, over days -252 to -43), and targets with a poison pill have a lower likelihood of succeeding.

A high offer premium also tends to increase the probability of takeover success, as does a relatively small run-down from the 52-week high target stock price. The latter variable is defined as $\frac{P_2}{P_{high}} - 1$, where P_{high} is the maximum stock price over the period [-252,-43]. Moreover, the coefficients for three dummy variables indicating a positive bidder toehold in the target (*Toehold*), a stock consideration exceeding 20% of the bidder's shares outstanding and thus requires acquirer shareholder approval ($>$ 20% *new equity*), and a hostile (vs. friendly or neutral) target reaction (*Hostile*), respectively, are all negative and significant. Finally, contests starting with a tender offer are more likely to succeed, as are contests announced in the 1990s and the 2000s. The dummy variable indicating an all-cash bid generates a significantly negative coefficient only when controlling for the time period (Column 2).

There are a total 6,103 targets with available data on the characteristics used in the probit estimation. For each of these, we multiply the markup with the estimated success probability computed using the second model in Table 4 (which includes the two decade dummies). This "expected markup" is then used in the nonlinear projection (3) reported in Table 3. Interestingly, the nonlinear form are now again able to remove the significant linear residual serial correlation from 0.027 (t=2.11) to an insignificant 0.016 (t=1.25) with the nonlinear estimation.[19]

[18] All takeovers in the early 1980s were successful, prohibiting the use of year dummies.

[19] Table 4, in columns 3-6, also show the coefficients from probit estimations of the probability that the initial control bidder wins the takeover contest. The pseudo-R^2 is somewhat higher than for this success probability, ranging from 22% to 28%. Columns 3 and 4 use the same models as the earlier estimations of contest success, while columns 5 and 6 add a variable capturing the percent of target shares owned by the initial control bidder at the time of the bid (*Toehold size*). Almost all explanatory variables generate coefficients that are similar in size, direction, and significance level to the ones in the probit regressions of contest success. The reason is that in the vast majority of

3.3.2 Information known before the runup period

Up to this point, we have assumed that the market imparts a vanishingly small likelihood of a takeover into the target price before the beginning of the runup period (day -42 in Figure 1). However, the market possibly receives information prior to the runup period that informs both the expected bid if a bid is made and the likelihood of a bid. To illustrate, consider the case where the market has a signal z at time zero. During the runup, the market receives a second signal s and, finally, a bid is made if $s + z$ exceeds a threshold level of synergy gains.

Working through the valuations, we have one important change. Define $\pi(z)E(B|z)$ as the expected value of takeover prospects given z and a diffuse prior on s. We then have that, at time zero in our model (event day -42 in our empirical analysis), $V_0 = \pi(z)E(B|z)$, and the runup and the bid premium would now be measured relative to V_0. Instead of V_R, the runup measured over the runup period is now

$$V_R - V_0 = \pi(s+z)E_{s+z}[B(S,C)] + T|s+z, bid] + [1 - \pi(s+z)]T - \pi(z)E(B|z), \qquad (13)$$

and the premium is

$$V_P - V_0 = E_{s+z}[B(S,C) + T|s+z, bid] - \pi(z)E(B|z)] - \pi(z)E(B|z). \qquad (14)$$

Setting aside the influence of T, for an investigation into the nonlinear influence of prior anticipation, one would want to add back V_0 to both the runup and the bid premium. Since the influence of V_0 is a negative one-for-one on both quantities, markups are not affected.

In order to unwind the influence of a possibly known takeover signal z prior to the runup period, we use the following three deal characteristics defined in Table 5: *Positive toehold*, *Toehold size*, and the negative value of 52$-$*week high*. The positive toehold means that the bidder at some point in the past acquired a toehold in the target. There is empirical evidence that toehold acquisitions announced through 13(d) filing with the SEC cause some market anticipation of a future takeover (Mikkelson and Ruback, 1985). Moreover, it is reasonable to assume that the signal is increasing in

successful contests, it is the initial bidder who wins control of the target. The only difference between the probability estimations is that the existence of a target poison pill does not substantially affect the likelihood that the initial bidder wins. The larger the initial bidder toehold, however, the greater is the probability that the initial bidder wins.

the size of the toehold. Moreover, Baker, Pan, and Wurgler (2010) report an impact of the target's 52-week high on takeover premiums.

Using these variables, model (4) reported in Table 3 implements two multivariate adjustments to model (1). The first adjustment, as dictated by eq. (13), augments the runup by adding R_0, where R_0 is the projection of the total runup ($\frac{P_{-2}}{P_{-42}} - 1$) on $Positive\ toehold$, $Toehold\ size$, and the negative value of $52 - week\ high$. The second adjustment is to use as dependent variable the "residual markup U_P, which is the residual from the projection of the total markup, $\frac{OP}{P_{-2}} - 1$, on the deal characteristics used to estimate the success probability π in Table 4, excluding $Positive\ toehold$, $Toehold\ size$, and $52 - week\ high$ which are used to construct the augmented runup.

Model (4) in Table 3 shows the linear and nonlinear projections of the residual markup on the augmented runup. The linear slope remains negative and highly significant (slope = -0.36, t = -12.1). The serial correlation of the ordered residuals from the linear projection is 0.052 with t = 4.03. After the nonlinear fit, the serial correlation drops to 0.031 with a t of 2.45. In this experiment the shape looks similar to the other nonlinear fits except that the right tail tips upward slightly. Thus, this evidence also supports the presence of a deal anticipation effect in the runup measured over the runup period.

3.3.3 Projections using abnormal stock returns

The last two projections in Table 3 use cumulative abnormal stock returns (CAR) to measure both the markup, $CAR(-1, 1)$, and the runup, $CAR(-42, -2)$. In projection (5), CAR is estimated using the market model amd in projection (6) we use the CAPM. The parameters of the return generating model are estimated on stock returns from day -297 through day -43. The CAR uses the model prediction errors over the event period (day -42 through day +1).

In projection (5), the linear residual serial correlation is a significant 0.039 (t=3.10), which is almost unchanged in the nonlinear form. Thus, we can reject the linearity of the projection. However, our specific nonlinear fit fails to remove the serial correlation. Interestingly, notice from Panel B of Figure 5 that the shape of our nonlinear form looks very much like the form in Panel A, in which the nonlinear form does succeed in eliminating the residual serial correlation.

4 Target runups and rational bidding

We have so far examined the relationship between offer markups and target runups. We now turn to implications of rational bidding for the relationship between bidder takeover gains and target runups given that bids are made. These implications turn out to be important for the overall conclusion of our empirical analysis.

4.1 Bidder valuations: Theory

Let ν denote bidder valuations, again measured in excess of stand-alone valuation at the beginning of the runup period. Valuation equations for the bidder are:

$$\nu_R = \int_K^\infty (S - C - B(S,C))g(S)dS, \tag{15}$$

where ν_R has the same interpretation as V_R for targets. At the moment of a bid announcement, but without knowing precisely what the final bid is, we again have that

$$\nu_P = \frac{1}{\pi(s)} \int_K^\infty (S - C - B(S,C))g(S)dS. \tag{16}$$

The observed valuation of the bidder after the bid is announced includes an uncorrelated random error around the expectation in equation (16) driven by the resolution of S around its conditional expectation.

Proposition 4 (rational bidding): *Let G denote the bidder net gains from the takeover ($G = S - C - B$). For a fixed benefit function G, rational bidding behavior implies the following:*
(i) Bidder and target synergy gains are positively correlated: $Cov(G, B) > 0$.
(ii) Bidder synergy gains and target runup are positively correlated: $Cov(G, V_R) > 0$.
(iii) The sign of the correlation between G and target markup $V_P - V_R$ is ambiguous.

Proof: See Appendix A.

Rational bidding inour context means that the bidder conditions the bid on the correct value of K. Figure 6 shows the theoretical relation between the bidder expected benefit ν_P and the target runup V_R for the uniform case with $\theta = 0.5$ and $\gamma = 1$. In panels A and B, the bidder rationally adjusts the bid threshold K to the scenario being considered: In Panel A, there is no transfer of the runup to the target, and so $K = \frac{\gamma C}{\theta}$ as in equations (1) and (2). In Panel B, the bidder transfers the runup, but also rationally adjusts the synergy threshold to $K^* = \frac{\gamma C + V_R}{\theta}$ (as in Section 2.3 above). In either case, the bidder expected benefit ν_P is increasing and concave in the target runup.

In Panel C of Figure 6, the bidder transfers the target runup but fails to rationally adjust the bid threshold from K to K^*. In this case, the bidder expected benefit is declining in V_R except at the very low end of the synergy signals which create very small runups. Panel C of Figure 6 joins Figure 4 and suggest that a powerful test of the feedback hypothesis is to test whether (1) the correlation between ν_P and V_R is negative and (2) that the projection of $V_P - V_R$ on V_R is positive. We have already shown that the data rejects the second of these two implications, and now turn to the first.

4.2 Are bidder gains increasing in target runups?

Proposition 4 and Panels A and B of Figure 6 show that, with rational market pricing and bidder behavior, bidder takeover gains ν_P are increasing in the target runup V_R. Bidder gains ν_P are decreasing in the target runup only if bidders fail to rationally compute the correct bid threshold level K. In this section we test this proposition empirically using the publicly traded bidders in our sample. We estimate ν_P as the cumulative abnormal bidder stock return, $BCAR(-42, 1)$, using a market model regression estimated over the period from day -297 through day -43 relative to the initial offer announcement date. The sample is N=3,691 initial control bids by U.S. publicly traded firms.

Table 6 shows linear projections of $BCAR(-42, 1)$ on our measures of target runups from Table 3. As predicted, the target runup receives a positive and significant coefficient in all six models in Table 6. All models are estimated with year dummies. In model (1), which uses the total target runup, the coefficient is 0.049 with a p-value of 0.006. Model (2) adds a number of controls for target-, bidder-, and deal characteristics, listed in the footnote of the table and also used in the estimation of the probability of success (Table 4). With these control variables, the slope coefficient on the target total runup is 0.054.[20]

[20] Of the control variables, *Relative size* and *All cash* receive significantly positive coefficients, while *Turnover*

In model (3), the target runup is net of the market return over the runup period and it receives a coefficient of 0.078 (p-value of 0.000). Model (4) again augments model (3) with the control variables, with a slope coefficient on the target net runup of 0.082. In model (5), the target runup is the *Augmented Target Runup* from Table 3 (to account for information about merger activity prior to the runup period). The slope coefficient is 0.049, again highly significant. Finally, Table 6 reports the projection of $BCAR$ on the market model target runup $CAR(-42, 2)$. The slope coefficient is 0.148 with a p-value of 0.000, again as predicted by our theory.

Next, we describe the full functional form of the projection of $BCAR$ on target runup. Consistent with the results of Table 6, the best linear projection of $BCAR$ on V_R shown in Figure 7 produces a significantly positive slope coefficient of 0.045 (the intercept is -0.019). The linear residual serial correlation is an insignificant 0.021 (t=1.27). After fitting the nonlinear model, the residual serial correlation drops to 0.016 (t=0.99). In Panel B of Figure 7, $BCAR$ is projected on the augmented target runup, producing an almost identical nonlinear shape.

Overall, the results of Table 6 and Panels A and B of Figure 7 show that the nonlinear fit of $BCAR$ on V_R is upward sloping and concave in V_R. The empirical shapes in Figure 7 have a striking visual similarity to the theoretical projections in panels A and B of Figure 6. The positive and monotone relationship between $BCAR$ and V_R rejects irrational bidding and is consistent with deal anticipation in the runup. It rejects *a fortiori* the negative relation shown in Panel C of Figure 6 implied by the case where the bidder agrees to a full transfer of the runup to the target without rationally adjusting the bid threshold K.

5 Effects of toehold purchases in the runup period

5.1 Hypothetical toehold costs/benefits

In theory, bidders have an incentive to acquire target shares in the target (a toehold) prior to making the bid. Bidder toehold benefits include a reduction in the number of target shares that must be acquired at the full takeover premium, and the expected profits from selling the toehold should a rival bidder win the target. However, as documented by Betton, Eckbo, and Thorburn (2009), toeholds are rare, indicating that such bidder toehold benefits are largely offset by toehold costs.

receives a significantly negative coefficient.

The takeover literature identifies several potential sources of toehold costs, ranging from market illiquidity (Ravid and Spiegel, 1999) and information disclosure (Jarrell and Bradley, 1980; Bris, 2002) to target resistance costs (Goldman and Qian, 2005; Betton, Eckbo, and Thorburn, 2009). We add to this literature by considering effects of toeholds purchased in the runup period—which we call "short-term toeholds". Specifically, we are interested in the possibility that short-term toehold acquisitions fuel costly target stock price runups.

An open-market purchase of a short-term toehold may provide rivals with time and information to prepare competing bids. There are several ways in which information in the toehold purchase reaches the market. First, if the target stock is illiquid, the purchase may cause abnormal movements in the stock price and attract investor scrutiny. Second, block trades and abnormal trading volume may also trigger media speculations that a firm is in play. For example, Jarrell and Poulsen (1989) show that media speculations result in significant share price runups. Third, the information in Schedule 13(d) filings discloses the toehold purchaser's intentions with the target, causing price effects (Mikkelson and Ruback, 1985). Fourth, the toehold purchase may trigger a pre-merger notification under the 1976 Hart-Scott-Rodino Antitrust Improvements Act.

Thus, a decision to acquire a short-term toehold must be weighted against the odds that the toehold creates costly competition. Competition among bidders raises the target's bargaining power and increases the target's share $(1-\theta)$ of the total synergy. This increase in turn manifests itself through a higher markup and total offer premium, and in reduced bidder gains. However, this is not the only possibility: because the expected toehold benefits allow the acquirer to bid more aggressively, toeholds may also *deter* competition (Bulow, Huang, and Klemperer, 1999) and allow the bidder to win more often. In this case, the target's share of the synergy gains are decreasing in the toehold.

The effect of a toehold purchase on expected bidder gains is therefore an open empirical question. If toeholds increase the bidder's bargaining power, the offer premium should be decreasing in the toehold (whether the toehold is held long- or short term prior to the offer). To address this issue, and to examine short-term toehold effects in the runup period, we use SDC to collect block trades during the runup period for our sample targets. We also record whether the block is purchased by the bidder or some other investor. Presumably, the potential for a block trade to fuel a costly target runup is greatest when the buyer is a potential acquirer.

5.2 Toeholds, runups, and offer premiums (H4)

Our toehold data is summarized in Table 7. We sample short-term toeholds in SDC over the period 1980-2008 by selecting "acquisitions of partial interest", where the bidder seeks to own less than 50% of the target shares. As shown in Panel A, over the six months preceding bid announcement [-126,0], the initial control bidders acquire a total of 136 toeholds in 122 unique target firms. Of these stakes, 104 toeholds in 94 different targets are purchased over the 42 trading days leading up to and including the day of the announcement of the initial control bid. Thus, less than 2% of our initial control bidders acquire a toehold in the runup period. For 98% of the target firms, the initial control bidder does not buy any short-term toehold. The typical short-term toehold acquired by the initial bidder in the runup period is relatively large, with a mean of 12% (median 9%).

The timing of the toehold purchase during the runup period is also interesting. Two-thirds of the initial control bidders' toehold acquisitions are announced on the day of or the day before the initial control bid [-1,0]. Since the SEC allows investors ten days to file a 13(d), we infer that these toeholds must have been purchased sometime within the 10-day period preceding and including the offer announcement day. For these cases, the target stock-price runup does not contain information from a public Schedule 13(d) disclosure (but will of course still reflect any market microstructure impact of the trades). The remaining short-term toeholds are all traded and disclosed in the runup period.

Panels B and C of Table 7 show toehold purchases by rival control bidders (appearing later in the contest) and other investors. Rival bidders acquire a toehold in the runup period for only 3 target firms. The average size of these rival short-term toeholds are 7% (median 6%). Other investors, not bidding for control in the contest, acquire toeholds in 73 target firms (1% of target firms) during the 42 days preceding the control bid. The announcement of 21% (18 of 85) of these toeholds coincide with the announcement of the initial control bid, suggesting that rumors may trigger toehold purchases by other investors. Overall, there are few purchases of toeholds in the two-month period leading up to the initial control bid.

Table 8 shows determinants of target net runups (columns 1-2) and initial offer premiums (columns 3-6) as a function of toeholds.[21] The dummy variables *Stake bidder* and *Stake other*

[21] Because the toehold decision is endogenous, we developed and tested a Heckman (1979) correction for endogeneity by including the estimated Mill's ratio (Maddala, 1983) in Table 8. See Betton, Eckbo, and Thorburn (2008b) for

indicate toehold purchases by the initial control bidder and any other bidder (including rivals), respectively, in the runup window through day 0.

Notice first that short-term toehold purchases by investors other than the initial bidder have a significantly positive impact on the net runup in both regressions. Furthermore, short-term toehold purchases by the initial bidder also increase the net runup, but with less impact on the runup: the coefficient for *Stake bidder* is 0.05 compared to a coefficient for *Stake other* of 0.12. While short-term toeholds tend to increase the runup, the total bidder toehold has the opposite effect. The variable *Toehold size*, which measures the fraction of the target's shares held by the initial bidder at the time of bid announcement, enters with a negative and significant sign. In sum, the evidence shows that only the short-term toehold purchases have a positive impact on target runups.[22]

Table 8 also shows coefficient estimates from OLS regressions for the initial offer premium. In addition to the explanatory variables from the regression model for the net runup, columns 3 and 4 further include the market return during the runup period. The offer premium is decreasing in *Toehold size*, a result also reported earlier by Betton and Eckbo (2000) and Betton, Eckbo, and Thorburn (2009).[23] Offer premiums are also decreasing in *Target size* and in 52-*week high*, both of which are highly significant. Moreover, as noted earlier in Section 3.2, offer premiums increase with the market return over the runup period, with a highly significant coefficient of 0.926 on *Market runup*.[24]

Finally, the two last regression models in columns 5 and 6 of Table 8 add the net runup. *Net runup* is highly significant but its inclusion does not affect the size or significance of the other variables. Not surprisingly, inclusion of the net runup increases the regression R^2 substantially, from 8% to 34%. In sum, despite fueling target runups, toehold bidding conveys a bidder benefit by lowering the total offer premium in the deal.

details of this analysis. As shown there, the coefficient on the Mill's ratio is not statistically significant, and it is therefore not included here.

[22]Several of the other explanatory variables for the target net runup receive significant coefficients. The smaller the target firm (*Target size*) and the greater the relative drop in the target stock price from its 52-week high (52-*week high*), the higher the runup. Moreover, the runup is higher when the acquirer is publicly traded and in tender offers, and lower for horizontal takeovers. The inclusion of year-fixed effects in the second column does not change any of the results.

[23]Note that the dummy for short-term toehold purchases have no separate impact on offer premiums, irrespectively of whether the purchase is by the initial control bidder or another investor.

[24]Offer premiums are also higher in tender offers and when the acquirer is publicly traded. The greater offer premiums paid by public over private bidders is also reported by Bargeron, Schlingemann, Stulz, and Zutter (2007).

6 Conclusions

There is growing interest in financial market feedback loops, in which economic agents may take corrective action based on information in stock price changes. We study this phenomenon in the rich context of offer price bargaining where the negotiating parties observe an economically significant target stock price runup. Since the true source of the runup (target stand-alone value change and/or deal anticipation) is unobservable, it is subject to interpretation by the bargaining parties which may result in a correction of the planned offer price. The problem for the bidder is that correcting the offer price when the runup reflects deal anticipation means "paying twice" for the target shares. Thus the outcome of this feedback loop is important for the incentive to make bids and, therefore, for the efficiency of the takeover process.

Earlier papers have examined this issue empirically by estimating the slope coefficient in linear cross-sectional regressions of the offer price markup (the offer price minus the runup) on the runup. Causal intuition suggests that this slope coefficient should be negative one under the deal anticipation hypothesis, as the runup substitutes dollar for dollar for the offer price markup. By extension, finding a coefficient greater than negative one has been taken to mean that runups tend to result in costly offer price markups.

Our structural empirical analysis leads to different conclusions. First, we show that rational market pricing implies a theoretical slope coefficient involving the conditional takeover probability ($\pi(s)$) when markups are projected on runups. This means that the projection is generally nonlinear and non-monotonic in the synergy signal (s), and so linear projections will produce slope coefficients that are strictly greater than negative one—and need not even be different from zero. We also show that when bidders mark up offers with target runups that are caused by deal anticipation (the feedback hypothesis), the implied relation between markups and runups is positive.

Our large-sample projection of offer price markups on runups yields a highly significant linear slope coefficients of -0.2. Using a residual serial correlation test, we also reject linearity and show that the nonlinear form of the projection corresponds closely to the theoretical expectation. Thus, the data is consistent with the deal anticipation hypothesis for runups. Moreover, our finding of a significantly negative slope coefficient estimate directly rejects the hypothesis that bidders feed back the runup into the offer price. Another interesting discovery is that offer premiums tend to be marked up by the *market return* over the runup period. It appears that the market component of the runup is interpreted by the negotiations as an exogenous change in the target's stand-alone value (which may be transferred to the target without the risk of "paying twice").

We also prove that market efficiency coupled with rational bidding implies a positive relationship between bidder takeover gains and *target* runups. This is true even if the outcome of merger negotiations is to feed the runup back into the offer price. With endogenous target runups there still exists an equilibrium with observed bids—but these necessarily have relatively large expected synergy gains to finance the runup transfer. Conversely, if bidders fail to rationally adjust their bid thresholds with the cost of the runup, the relationship between observed bidder gains and target runups will be negative. The estimated relationship is significantly positive in our data, which rejects bidder irrationality.

Finally, we investigate the effect of bidder toeholds in the target. Bidding theories suggest that toeholds increase bidder bargaining power and thus affect offer premiums. Consistent with previous toehold studies, we find that bids which involve toeholds on average command lower premiums than bids without toeholds. Our analysis separate out toehold purchases in the runup period and find that these tend to fuel fuel target runups. However, there is no evidence that the greater target runup causes offer premium markups. A consistent explanation is that bidders are able to convince the target that the extra runup reflects deal anticipation triggered by the toehold purchase rather than a change in the target stand-alone value.

A Appendix: Proofs of lemma 1 and Proposition 4

lemma 1 (linear projection): *With deal anticipation, and as long as the takeover probability π is a function of the synergy gains S, a linear projection of $V_P - V_R$ on V_R yields a slope coefficient that is strictly greater than -1, and the coefficient need not be different from zero.*

Proof: For the first part of the lemma, it suffices to show that the maximum negative slope in the projection of the expected markup on the runup is greater than -1. Differentiation of equation (6) shows that the slope becomes more negative as s increases. The most negative slope is at the maximum s that still causes uncertainty in the bid. This point is reached when $s = (\gamma/\theta)C + \Delta$. Substitution into the ratio $(V_P - V_R)/V_R$ yields $-A/[A + (1-\theta)\Delta]$, where $A = (1-\theta)\Delta + (\gamma/\theta)C$. Since $A \geq 0$, this ratio must be greater than -1. For the second part of the lemma, note that equation (6) equals zero at the point where $s = (1-\gamma)/(1-\theta)C$. Such a point is viable whenever $(1-\gamma)/(1-\theta)C + \Delta \geq \gamma C/\theta$, and $0 < \theta < 1$. There always exists a Δ for which this is true. ■

Proposition 4 (rational bidding): *Let G denote the bidder synergy gains from the takeover. For a fixed benefit function G, rational bidding behavior implies the following:*

(1) Bidder and target synergy gains are positively correlated: $Cov(G, B) > 0$:

(ii) Bidder synergy gains and target runup are positively correlated: $Cov(G, V_R) > 0$

(iii) The sign of the correlation between G and target markup $V_P - V_R$ is ambiguous.

Proof: For the first part (i), recall that we have assumed that, if a bid is made, the bidder and target share in the synergy gains $(1 < \theta < 1)$, implying $0 < \frac{\partial B(S,C)}{\partial S} < 1$. It follows immediately that both the bidder and target gains increase in S throughout the entire range of S wherein bids are possible. This includes ranges over which bids are certain given the signal, s. In the case of our closed form example above, write out the target gain, $B = (1-\theta)S - (1-\gamma)C$, and the bidder gain, $G = \theta S - \gamma C$. Clearly, both B and G are increasing (and linear) in S.[25] To prove the rest of Proposition 4 it is necessary to work with the conditional distribution of s given S, which we denote $f(s|S)$. Knowledge of $f(s|S)$ is required to determine the expected value of the runup for

[25] In the example, and measuring $Cov(G, B)$ as the product of the derivatives of G and B w.r.t. S, $Cov(G, B) = \theta(1-\theta)$. This means that the expected "slope coefficient" of a projection of G on B equals $\theta/(1-\theta)$.

a given observed S, revealed when the bid is made. When S is revealed through the bid, s is random in the sense that many signals could have been received prior to the revelation of S. For (ii), the covariance between the target runup and the bidder gains is the covariance between the expected runup, at a given S, and the bidder gain, at the same S. This covariance is measured by the product of derivatives so it suffices to show that the derivative of the expected runup is always positive to prove the second part of the proposition. To prove the last part (iii) of the proposition, it must be shown that the derivative of the expected markup is not always less than $1-\theta$ for all S.

While proof of (ii) and (iii) can be generalized, we focus on the case where the prior distribution of S is diffuse and the posterior distribution of S, given s is uniform (our closed-form example). With diffuse prior, the law of inverse probability implies that $f(s|S)$ is proportional to the posterior distribution of S given s, or $f(s|S) \sim U(S-\Delta,\ S+\Delta)$. We now have

$$E_s(V_R) \propto \int_{S-\Delta}^{S+\Delta} V_R(s) f(s|S) ds \tag{17}$$

Since $f(s|S)$ is a constant in our case, differentiation by S through Leibnitz rule gives the simple form:

$$\frac{\partial E_s(V_R)}{\partial S} = V_R(s = S+\Delta) - V_R(s = S-\Delta) \tag{18}$$

By inspection, $V_R(s)$ in equation (4) is increasing in s. This establishes that the $Cov(G, E(V_R)) > 0$ for all viable bids including bids which are certain.

Part (iii) of proposition 4 relates to $Cov(G,\ E_s(V_R))$. Since the target markup equals $B - E_s(V_R)$, we need to evaluate the sign of the derivative of this difference with respect to S. Define $E[M(S)] = B - E_s(V_R)$. Applying similar logic,

$$\frac{\partial E(M)}{\partial S} = (1-\theta) - [V_R(S+\Delta) - V_R(S-\Delta)] \tag{19}$$

Inspection of Figure 2 clearly shows that the “slope” of the difference in runups at $S+\Delta$ an $S-\Delta$ depends on S and need not be less than $1-\theta$, the slope of V_P in the figure. Thus the covariance between bidder gain and expected target markup need not be positive in a sample of data drawn over any range of S. If the range of S happens to cover (uniformly) the entire range of viable bids that are uncertain, there is no clear covariance between bidder gain and expected target markup.■

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Figure 1
The takeover information arrival process and average target runup in event time

The runup period is measured from day -42 through day -1 relative to the first public offer for the target (day 0). The offer announcement period is day -1 through 0. The figure plots the percent average target abnormal (market risk adjusted) stock return in the runup and announcement periods for the total sample of 6,150 U.S. public targets (1980-2008). The average abnormal return in the runup period is 12% while the announcement-period return (markup) is 25%.

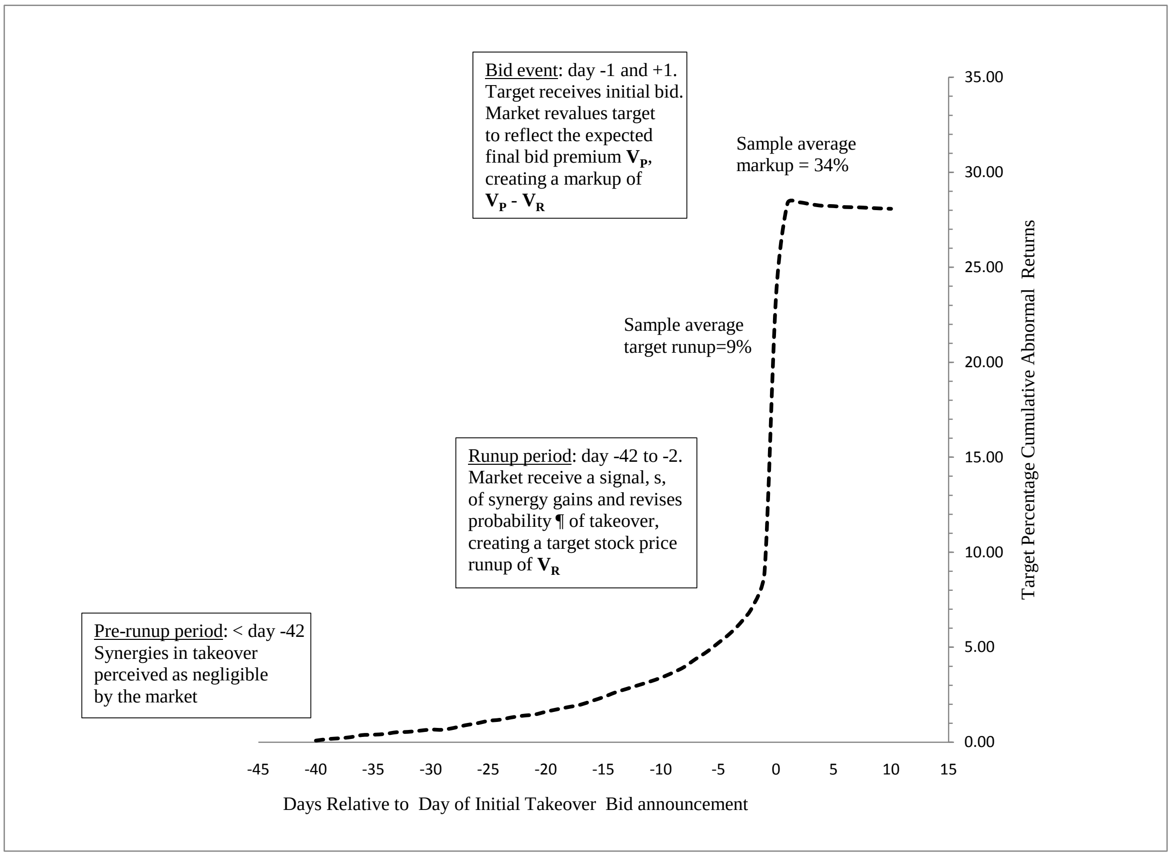
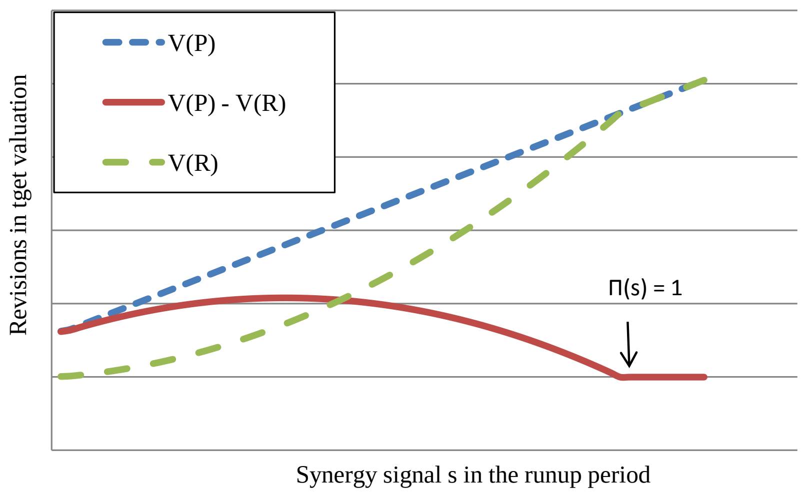


Figure 2
Theoretical markup projections with only deal anticipation in the runup.

V_R is the expected target runup, V_P is the expected offer price, $V_P - V_R$ is the offer price markup, and $\pi(s)$ is the probability of a takeover given the synergy signal s in the runup period. The synergy S given s is distributed uniform. Panel A shows the target valuations as a function of s, while Panel B shows the theoretical projection of the markup on the target runup. The takeover benefit function has target and bidder equally sharing synergy gains ($\theta = 0.5$), while bidder bears the entire bid cost ($\gamma = 1$). The expected markup approaches zero as the anticipated deal probability $\pi(s)$ approaches one.

A: Valuation changes conditional on a synergy signal s and on a bid



B: Theoretical projection of the markup V_p-V_R on the runup V_R

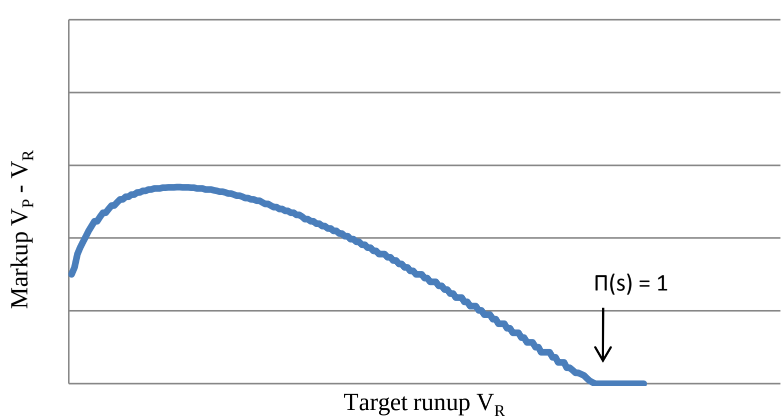


Figure 3
Theoretical markup projections with stand-alone value change T in the runup.

The target stand-alone value changes by a known value T in the runup period. The figure shows that sample variation in T flattens the projection of markup on runup. The solid line is the average expected markup computed as the vertical summation of expected markups occurring across sub-samples with different changes in target stand-alone value T. Dashed lines are relations within a sub-sample having the same change in target stand-alone value. Uncertainty in the signal s is uniform, and benefit sharing is as in Figure 2. $\pi(s)$ is the probability of a takeover given the synergy signal s.

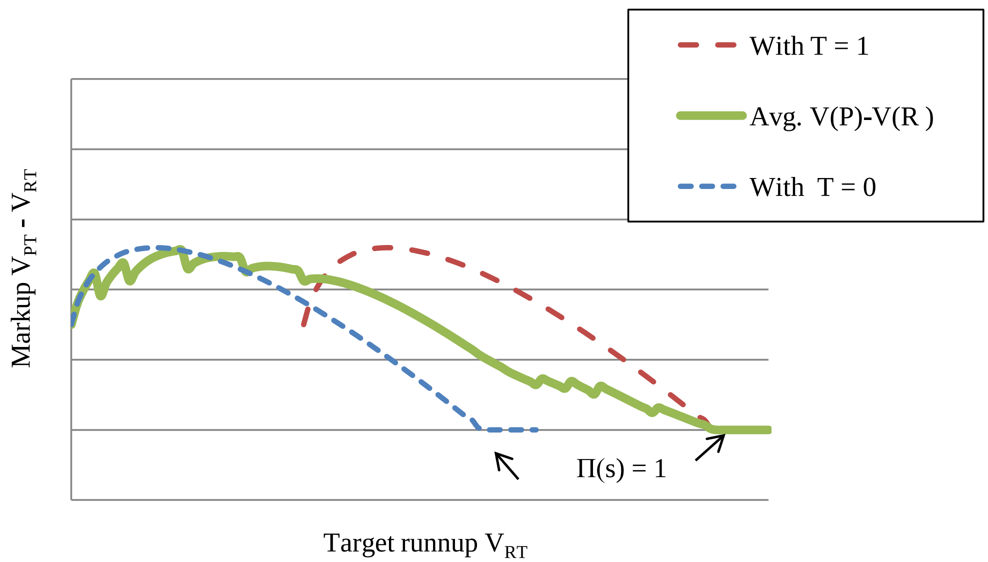


Figure 4
Theoretical markup projections with runup transferred to target ("paying twice").

All parameters are as in Figure 2, except that the bid now also includes the target runup V_R. This changes the conditional probability of a takeover from $\pi(s)$ to $\pi^*(s, V_R)$ (right-side vertical axis of Panel B). While the signal scale in Panel A and B are the same, Panel A shows the projection of markup on runup without transferring V_R to the target. This serves to illustrate that the effect of "paying twice" is to eliminate relatively low-synergy takeovers from the sample, leaving only those bidders with sufficient synergy gains to pay for the transfer (and still find it beneficial to make a bid). As a result, given the sample of high-synergy bidders, the probability $\pi(s)$ quickly reaches one in Panel A where the bidder does not need to transfer V_R. In Panel B, the probability $\pi^*(s, V_R)$ never exceeds 0.5, and it is only 0.37 when $\pi(s) = 1$.

A: Valuation changes with no transfer of runup to target

B: Valuation changes with transfer of runup to target

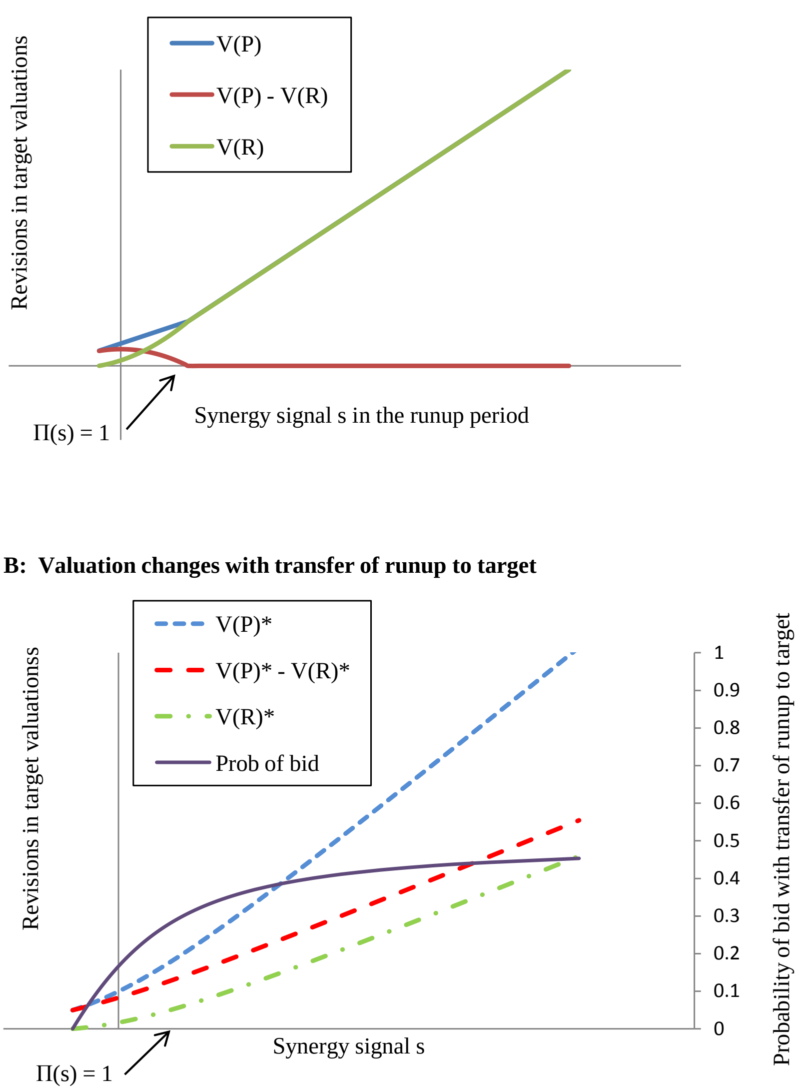
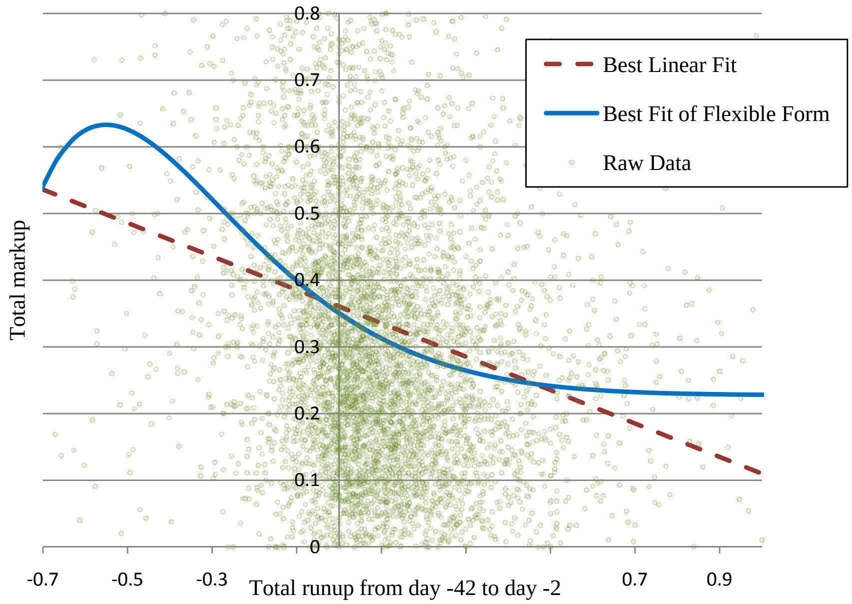


Figure 5
Empirical markup projections for the total sample of 6,150 bids, 1980-2008.

In Panel A, the markup is measured as $\frac{OP}{P_{-2}} - 1$, where OP is the offer price and P_{-2} is the target stock price on day -2 relative to the first offer announcement date, and the runup is $\frac{P_{-2}}{P_{-42}} - 1$. In Panel B, the markup is the Marked Model $CAR(-1,1)$ and the runup is $CAR(-42,-2)$. A flexible form (equation 12 in the text) is used to contrast linear fit with best fit.

A: Projections of total markup on total runup:



B: Projections of Market Model CAR(-1,1) on CAR(-42,-2)

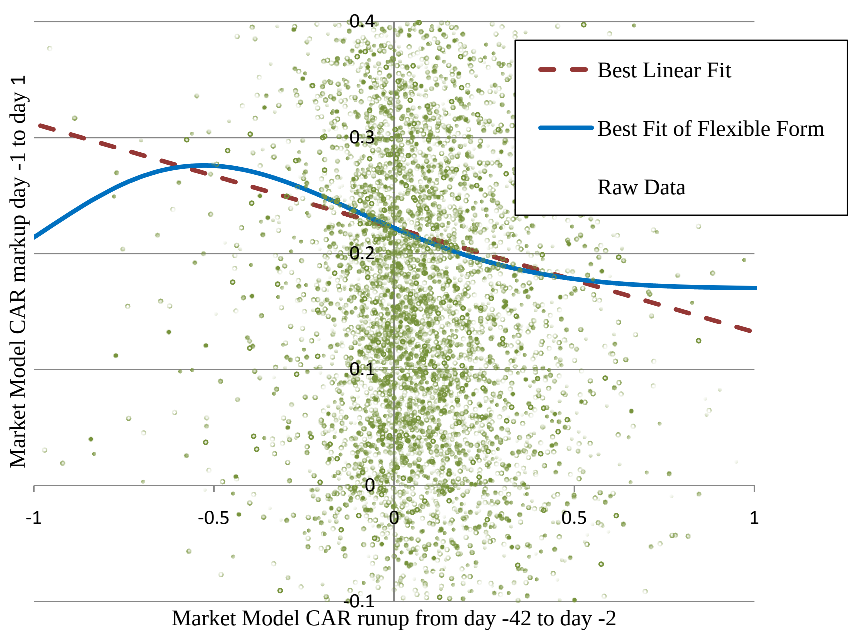


Figure 6
Theoretical projections of bidder merger gains ν_P on target runup V_R with and without feeding V_R back into the offer price.

The market receives a synergy signal s in the runup period resulting in the conditional expected synergy to be embedded into the stock prices of the bidder and the target. Uniform case with target and bidder shares equally synergy gains ($\theta = 0.5$) and bidder bears all bid cost ($\gamma = 1$). In Panel A, the bidder does not transfer the runup V_R to the target. In Panel B, bidder transfers V_R and rationally adjusts the minimum bid threshold to $K^* = \frac{\gamma C + V_R}{\theta}$. In Panel C, bidder also transfers V_R to the target but does not adjust the minimum bid threshold to $K^* =$ (it remains at $K = \frac{\gamma C}{\theta}$). Thus, in both Panel B and C the bidder "pays twice", but only in Panel C does the bidder fail to take this extra takeover cost into account ex ante.

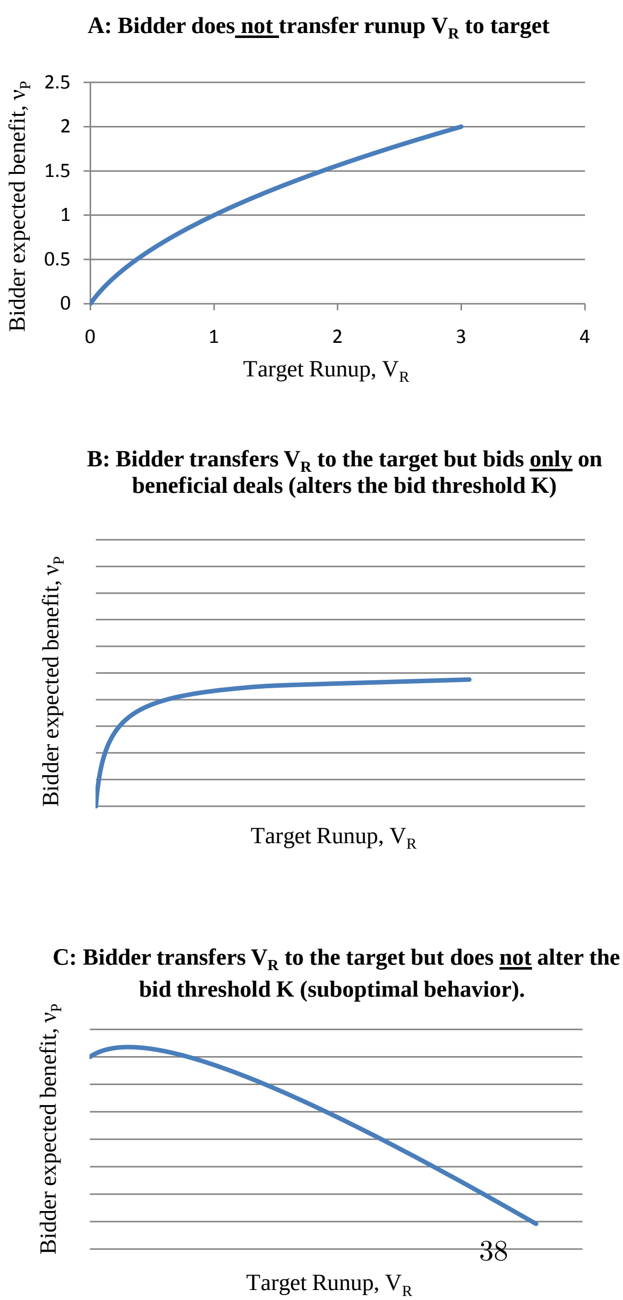
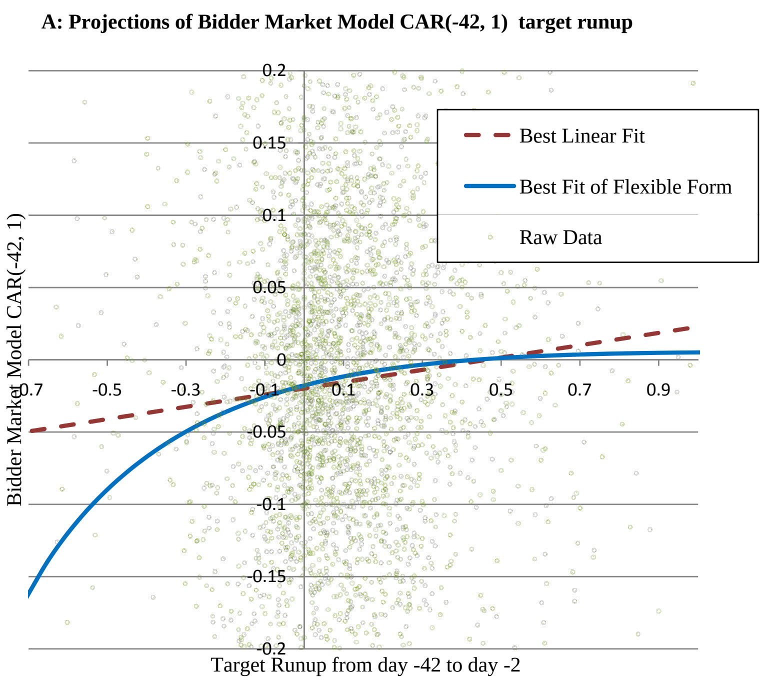


Figure 7
Empirical projections of bidder gains on target runups, 1980-2008.

Bidder takeover gains (ν_P) is measured as the Market Model bidder $CAR(-42,1)$ relative to the first announcement date of the offer. In Panel A, the target runup is $\frac{P_{-2}}{P_{-42}} - 1$, where P_{-2} is the target stock price on day -2 relative to the first offer announcement date. Panel B uses the augmented target runup (defined in the text and in Table 3). A flexible form (equation 12 in the text) is used to contrast linear fit with best fit. Sample of 3,689 public bidders.



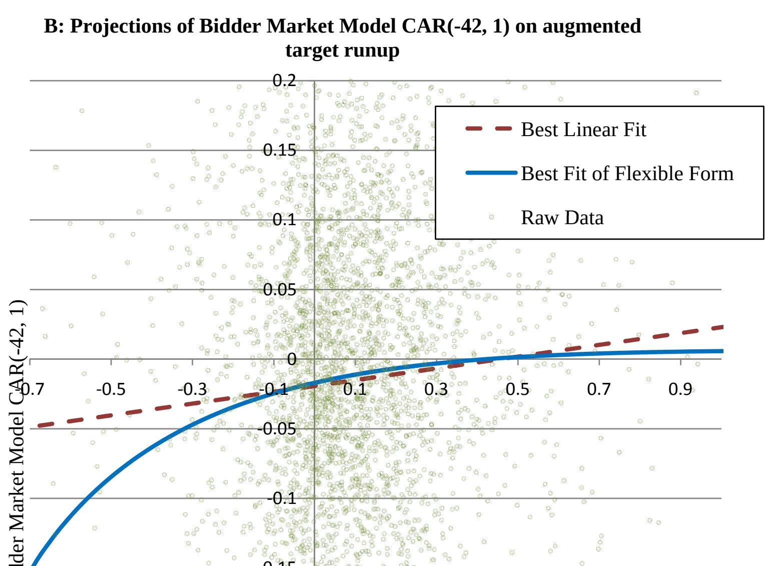


Table 1
Sample selection

Description of the sample selection process. An initial bid is the first control bid for the target in 126 trading days (six months). Bids are grouped into takeover contests, which end when there are no new control bids for the target in 126 trading days. All stock prices p_i are adjusted for splits and dividends, where i is the trading day relative to the date of announcement (day 0).

Selection criteria	Source	Number of exclusions	Sample size
All initial controlbids in SDC (FORMC = M, AM) for US public targets during the period 1/1980-12/2008	SDC		13,893
Bidder owns <50% of the target shares at the time of the bid	SDC	46	13,847
Target firm identified in CRSP and listed on NYSE, AMEX or NASDAQ	CRSP	4,138	9,109
Deal value > \$10 million	SDC	1,816	7,293
Target stock price on day -42 > \$1	CRSP	191	7,102
Offer price available	SDC	239	6,863
Target stock price on day -2 available	CRSP	6	6,857
Target announcement returns [-1,1] available	CRSP	119	6,738
Information on outcome and ending date of contest available	SDC	324	6,414
Contest shorter than 252 trading days	SDC	264	6,150
Final sample			6,150

Table 2
Sample size, offer premium, markup, and runup, by year

The table shows the mean and median offer premium, markup, target stock-price runup and net runup for the sample of 6,150 initial control bids for U.S. publicly traded target firms in 1980-2008. The premium is $(OP/P_{-42}) - 1$, where OP is the price per share offered by the initial control bidder and P_i is the target stock price on trading day i relative to the takeover announcement date ($i = 0$), adjusted for splits and dividends. The markup is $(OP/P_{-2}) - 1$, the runup is $(P_{-2}/P_{-42}) - 1$ and and the net runup is $(P_{-2}/P_{-42}) - (M_{-2}/M_{-42})$, where M_i is the value of the equal-weighted market portfolio on day i.

	Sample size	Offer premium $\frac{OP}{P_{-42}} - 1$		Markup $\frac{OP}{P_{-2}} - 1$		Runup $\frac{P_{-2}}{P_{-42}} - 1$		Net runup $\frac{P_{-2}}{P_{-42}} - \frac{M_{-2}}{M_{-42}}$	
Year	N	mean	median	mean	median	mean	median	mean	median
1980	10	0.70	0.69	0.53	0.34	0.15	0.19	0.10	0.12
1981	35	0.60	0.48	0.40	0.36	0.15	0.13	0.16	0.14
1982	48	0.53	0.48	0.34	0.32	0.15	0.10	0.13	0.09
1983	58	0.49	0.50	0.33	0.35	0.12	0.12	0.10	0.08
1984	115	0.51	0.43	0.45	0.32	0.07	0.05	0.06	0.06
1985	161	0.40	0.34	0.26	0.22	0.11	0.10	0.08	0.06
1986	209	0.40	0.36	0.26	0.23	0.12	0.09	0.08	0.06
1987	202	0.39	0.36	0.32	0.25	0.07	0.07	0.06	0.03
1988	270	0.56	0.47	0.35	0.29	0.15	0.10	0.12	0.08
1989	194	0.54	0.43	0.39	0.30	0.11	0.07	0.07	0.03
1990	103	0.53	0.49	0.49	0.41	0.05	-0.00	0.05	-0.01
1991	91	0.55	0.46	0.40	0.33	0.12	0.09	0.08	0.05
1992	106	0.57	0.51	0.40	0.35	0.13	0.08	0.11	0.08
1993	146	0.48	0.43	0.36	0.33	0.10	0.07	0.08	0.05
1994	228	0.44	0.42	0.34	0.31	0.08	0.07	0.07	0.07
1995	290	0.47	0.39	0.33	0.27	0.11	0.09	0.06	0.04
1996	319	0.40	0.37	0.27	0.24	0.11	0.07	0.07	0.04
1997	434	0.41	0.38	0.26	0.23	0.13	0.12	0.09	0.08
1998	465	0.46	0.37	0.37	0.26	0.08	0.07	0.05	0.03
1999	496	0.55	0.45	0.37	0.30	0.15	0.11	0.12	0.08
2000	415	0.53	0.45	0.38	0.34	0.13	0.06	0.12	0.08
2001	270	0.55	0.46	0.40	0.34	0.11	0.08	0.12	0.09
2002	154	0.52	0.36	0.42	0.32	0.09	0.03	0.12	0.06
2003	189	0.47	0.34	0.30	0.23	0.13	0.08	0.09	0.05
2004	195	0.30	0.26	0.24	0.21	0.06	0.04	0.03	0.02
2005	230	0.30	0.27	0.25	0.21	0.05	0.04	0.04	0.03
2006	258	0.31	0.27	0.25	0.21	0.05	0.03	0.03	0.02
2007	284	0.31	0.28	0.29	0.23	0.02	0.02	0.00	0.00
2008	175	0.34	0.30	0.40	0.34	-0.04	-0.04	0.01	0.00
Total	6,150	0.45	0.38	0.33	0.27	0.10	0.07	0.08	0.05

Table 3
Linear and nonlinear projections of markups ($V_P - V_R$) on runups (V_R)

The linear projections is a simple OLS regression of the markup on the runup. The nonlinear projection is

$$Markup = \alpha + \beta[(r - min)^{(v-1)}(max - r)^{w-1}/\Lambda(v, w)(max - min)^{v+w-1}] + \epsilon,$$

where $\Lambda(v, w)$ is the beta distribution with shape parameters v and w, r is the runup, max and min are respectively the maximum and minimum runups in the data, α is an overall intercept, β is a scale parameter, and ϵ is a residual error term. The projection uses a starting values $v = 1, w = 2$ (for which the beta density is linear downward sloping) and the OLS estimates of a and b (for α and β), followed by a least squares fit over all four parameters to identify a best non-linear shape. For all of the projections in this table, the resulting form of the non-linearity corresponds closely to that shown in Figure 5 for projection (1), and are thus consistent with the general concave then convex shape shown in the theoretical Figure 2. First-order residual serial correlation is calculated after ordering the data by runup. Using the t-statistic (in parentheses), a significant positive residual serial correlation rejects the hypothesis that the true projection is linear and is consistent with deal anticipation driving a portion of the runup.

	N	Markup measure $V_P - V_R$	Runup measure V_R	Linear projection $V_P - V_R = a + bV_R$	Linear residual serial correlation	Nonlinear residual serial correlation
(1)	6,150	Total markup	Total runup	$a = 0.36$	0.030	0.015
		$\frac{OP}{P_{-2}} - 1$	$\frac{P_{-2}}{P_{-42}} - 1$	$b = -0.24$ (-11.9)	(2.36)	(1.15)
(2)	5,035[a]	Total markup	Total runup	$a = 0.36$	0.045	0.027
		$\frac{OP}{P_{-2}} - 1$	$\frac{P_{-2}}{P_{-42}} - 1$	$b = -0.22$ (-10.1)	(3.21)	(2.19)
(3)	6,103	Expected markup[b]	Total runup	$a = 0.31$	0.027	0.016
		$\pi[\frac{OP}{P_{-2}} - 1]$	$\frac{P_{-2}}{P_{-42}} - 1$	$b = -0.17$ (-9.5)	(2.11)	(1.25)
(4)	6,150	Residual markup[c]	Augmented runup[d]	$a = 0.36$	0.052	0.031
		U_P	$(\frac{P_{-2}}{P_{-42}} - 1) + R_0$	$b = -0.21$ (-12.1)	(4.03)	(2.45)
(5)	6,150	Market Model[e]	Market Model[e]	$a = 0.22$	0.039	0.038
		$CAR(-1, 1)$	$CAR(-42, -2)$	$b = -0.09$ (-6.7)	(3.10)	(2.95)

[a]This projection is for the subsample where the initial bid in the contest ultimately leads to a control change in the target (successful targets).
[b]This projection is for the subsample with available data on the target–, bidder– and deal characteristics used to estimate the probability π of bid success in Table 4. The projection includes the effect of these variables by multiplying the total markup with the estimated value of π.
[c] Residual markup, U_P, is the residual from the projection of the total markup, $\frac{OP}{P_{-2}} - 1$, on the deal characteristics used to estimate the success probability π in Table 4, excluding *Positive toehold*, *Toehold size*, and $52 - week\ high$ which are used to construct the augmented runup. Variable definitions are in Table 5.
[d] The enhancement R_0 in the augmented runup adds back into the runup the effect of information that the market might use to anticipate possible takeover activity *prior* to the runup period. R_0 is the projection of the total runup $(\frac{P_{-2}}{P_{-42}} - 1)$ on the deal characteristics *Positive toehold*, *Toehold size*, and the negative value of $52 - week\ high$, all of which may affect the prior probability of a takeover (prior to the runup period). The augmented runup is the total runup plus R_0. Variable definitions are in Table 5.
[e] Target cumulative abnormal stock returns (CAR) are computed using the estimated Market Model parameters: $r_{it} = \alpha + \beta r_{mt} + u_{it}$, where r_{it} and r_{mt} are the daily returns on stock i and the value-weighted market portfolio, and u_{it} is a residual error term. The estimation period is from day -297 to day -43 relative to the day of the announcement of the initial bid.

Table 4
Probability of contest success

The table shows coefficient estimates from logit regressions for the probability that the contest is successful (columns 1-2) and that the initial control bidder wins (columns 3-6). P-values are in parenthesis. The sample is 6,103 initial control bids for public US targets, 1980-2008, with a complete set of control variables (defined in Table 5).

Dependent variable:	Contest successful		Initial control bidder wins			
Intercept	1.047	0.909	0.657	0.455	0.626	0.437
	(0.000)	(0.000)	(0.000)	(0.005)	(0.000)	(0.007)
Target characteristics						
Target size	0.137	0.085	0.148	0.094	0.150	0.096
	(0.000)	(0.005)	(0.000)	(0.001)	(0.000)	(0.001)
NYSE/Amex	-0.365	-0.269	-0.435	-0.330	-0.433	-0.329
	(0.000)	(0.005)	(0.000)	(0.000)	(0.000)	(0.000)
Turnover	-0.017	-0.019	-0.017	-0.019	-0.017	-0.019
	(0.002)	(0.001)	(0.002)	(0.001)	(0.003)	(0.001)
Poison pill	-0.578	-0.513	-0.506	-0.436	-0.406	-0.341
	(0.028)	(0.053)	(0.063)	(0.114)	(0.138)	(0.219)
$52 - week\ high$	1.022	1.255	0.864	1.117	0.868	1.120
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Bidder characteristics						
Toehold	-0.819	-0.688	-0.978	-0.833	-1.589	-1.419
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Toehold size					0.039	0.038
					(0.000)	(0.000)
Acquirer public	0.833	0.804	0.938	0.900	0.952	0.915
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Horizontal	0.248	0.211	0.276	0.226	0.281	0.232
	(0.020)	(0.050)	(0.006)	(0.025)	(0.005)	(0.022)
$> 20\%$ *new equity*	-0.585	-0.577	-0.531	-0.522	-0.536	-0.526
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Premium	0.343	0.371	0.334	0.365	0.350	0.380
	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
Deal characteristics						
Tender offer	2.173	2.307	1.912	2.053	1.945	2.085
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Cash	-0.148	-0.276	-0.105	-0.224	-0.114	-0.236
	(0.119)	(0.005)	(0.236)	(0.014)	(0.199)	(0.010)
Hostile	-2.264	-2.149	-3.086	-2.980	-2.994	-2.893
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$1990s$		0.435		0.566		0.548
		(0.000)		(0.000)		(0.000)
$2000s$		0.775		0.824		0.816
		(0.000)		(0.000)		(0.000)
Pseudo-R^2 (Nagelkerke)	0.208	0.219	0.263	0.276	0.269	0.281
χ^2	755.1	795.8	1074.0	1129.3	1098.5	1151.8

Table 5
Variable definitions

Variable definitions. All stock prices P_i are adjusted for splits and dividends, where i is the trading day relative to the date of announcement ($i = 0$), and, if missing, replaced by the midpoint of the bid/ask spread.

Variable	Definition	Source
A. Target characteristics		
Target size	Natural logarithm of the target market capitalization in $ billion on day -42	CRSP
Relative size	Ratio of target market capitalization to bidder market capitalization on day -42	CRSP
NYSE/Amex	The target is listed on NYSE or Amex vs. NASDAQ (dummy)	CRSP
Turnover	Average daily ratio of trading volume to total shares oustanding over the 52 weeks ending on day -43	CRSP
Poison pill	The target has a poison pill (dummy)	SDC
52-week high	Change in the target stock price from the highest price P_{high} over the 52-weeks ending on day -43, $P_{-42}/P_{high} - 1$	CRSP
B. Bidder characteristics		
Toehold	The acquirer owns shares in the target when announcing the bid (dummy)	SDC
Toehold size	Percent target shares owned by the acquirer when announcing the bid	SDC
Stake bidder	The initial bidder buys a small equity stake in the target during the runup period (dummy)	SDC
Stake other	Another investor buys a small equity stake in the target during the runup period (dummy)	SDC
Acquirer public	The acquirer is publicly traded (dummy)	SDC
Horizontal	The bidder and the target has the same primary 4-digit SIC code (dummy)	SDC
>20% new equity	The consideration includes a stock portion which exceeds 20% of the acquirer's shares oustanding (dummy)	SDC
C. Contest characteristics		
Premium	Bid premium defined as $(OP/P_{-42}) - 1$, where OP is the offer price.	SDC,CRSP
Markup	Bid markup defined as $(OP/P_{-2}) - 1$, where OP is the offer price.	SDC,CRSP
Runup	Target raw runup defined as $(P_{-2}/P_{-42}) - 1$	CRSP
Net runup	Target net runup defined as $(P_{-2}/P_{-42}) - (M_{-2}/M_{-42})$, where M_i is the value of the equal-weighted market portfolio on day i.	CRSP
Market runup	Stock-market return during the runup period defined as $M_{-2}/M_{-42} - 1$, where M_i is the value of the equal-weighted market portfolio on day i.	CRSP
Tender offer	The initial bid is a tender offer (dummy)	SDC
All cash	Consideration is cash only (dummy)	SDC
All stock	Consideration is stock only (dummy)	SDC
Hostile	Target management's response is hostile vs. friendly or neutral (dummy)	SDC
Initial bidder wins	The initial bidder wins the contest (dummy)	SDC
1990s	The contest is announced in the period 1990-1999 (dummy)	SDC
2000s	The contest is announced in the period 2000-2008 (dummy)	SDC

Table 6
Projections of bidder returns (ν_P) on target runup (V_R)

The table shows OLS estimates of bidder cumulative abnormal returns $\nu_P = BCAR(-42, 1)$, from a market model estimated over day -297 through -43. All regressions control for year fixed effects. The p-values (in parenthesis) use White's (1980) heteroscedasticity-consistent standard errors. Total sample of initial control bids by U.S. public bidders, 1980-2008.

	Regression model					
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	-0.116	-0.116	-0.110	-0.114	-0.097	-0.099
	(0.091)	(0.102)	(0.979)	(0.102)	(0.486)	(0.288)
Total Target Runup	0.049	0.054				
$V_R = \frac{P_{-2}}{P_{-42}} - 1$	(0.006)	(0.003)				
Net Target Runup[a]			0.078	0.082		
$V_{RT} = \frac{P_{-2}}{P_{-42}} - \frac{M_{-2}}{M_{-42}}$			(0.000)	(0.000)		
Augmented Target Runup[b]					0.049	
$V_R = (\frac{P_{-2}}{P_{-42}} - 1) + R_0$					(0.006)	
Market Model Target Runup[c]						0.148
$V_{RT} = CAR(-42, 2)$						(0.000)
Control variables[d]	no	yes	no	yes	no	no
Adjusted R^2	0.019	0.025	0.019	0.049	0.043	0.049
Sample size, N	3,691	3,689	3,660	3,691	3,624	3,623

[a] $\frac{M_{-2}}{M_{-42}}$ is the return on the equal-weighted market portfolio in the runup period (from day -42 to day -2).

[b] The enhancement R_0 in the augmented runup adds back into the runup the effect of information that the market might use to anticipate possible takeover activity *prior* to the runup period. R_0 is the projection of the total runup $(\frac{P_{-2}}{P_{-42}} - 1)$ on the deal characteristics *Positive toehold*, *Toehold size*, and the negative value of $52 - week\ high$, all of which may affect the prior probability of a takeover (prior to the runup period). The augmented runup is the total runup plus R_0. Variable definitions are in table 5.

[c] Target cumulative abnormal stock returns (CAR) are computed using the estimated Market Model parameters: $r_{it} = \alpha + \beta r_{mt} + u_{it}$, where r_{it} and r_{mt} are the daily returns on stock i and the value-weighted market portfolio, and u_{it} is a residual error term. The estimation period is 252 trading days prior to day -42 relative to the day of the announcement of the initial bid.

[d] There are three categories of control variables. (1) Target characteristics: *Relative size*, *NYSE/Amex*, and *Turnover*. (2) Bidder characteristics: *Toeholdsize* and *Horizontal*.(3) Deal characteristics: *All cash*, *All stock*, and *Hostile*. See Table 5 for variable definitions. Of these variables, *Relative size* and *All cash* receive significantly positive coefficients, while *Turnover* receives a significantly negative coefficient. The remaining control variables are all insignificantly different from zero.

Table 7
Description of toeholds purchased in the target firm

The table shows toehold acquisitions made by the initial control bidder, a rival control bidder, and other investors. Stake purchases are identified from records of completed partial acquisitions in SDC. The initial control bid is announced on day 0. The sample is 6,150 initial control bids for U.S. publicly traded targets, 1980-2008.

		Target stake announced in window			Total toehold on day 0
		[-126,0]	[-42,0]	[-1,0]	
A: Toehold acquired by initial control bidder					
Number of toehold purchases		136	104	70	
Number of firms in which at least one stake is purchased		122	94	63	648
In percent of target firms		2.0%	1.5%	1.0%	10.5%
Size of toehold (% of target shares) when toehold positive:	mean	12.2%	11.7%	12.7%	15.5%
	median	9.9%	9.3%	9.4%	9.9%
B: Toehold acquired by rival control bidder					
Number of toehold purchases		7	3	1	
Number of firms in which at least one stake is purchased		6	3	1	
In percent of target firms		0.1%	0.05%	0.02%	n/a
Size of toehold (% of target shares) when toehold positive:	mean	9.4%	7.0%	4.9%	
	median	9.1%	6.2%	4.9%	
C: Toehold acquired by other investor					
Number of toehold purchases		235	85	18	
Number of firms in which at least one stake is purchased		196	73	15	
In percent of target firms		3.2%	1.2%	0.2%	n/a
Size of toehold (% of target shares) when toehold positive:	mean	6.8%	8.7%	10.1%	
	median	5.4%	6.3%	7.6%	

Table 8
Target runup and initial offer premium

The table shows coefficient estimates from OLS regressions of the target net runup and the initial offer premium. The net runup is $(P_{-2}/P_{-42}) - (M_{-2}/M_{-42})$ and the offer premiums is $(OP/P_{-42}) - 1$, where P_i is the target stock price and M_i is the value of the equal-weighted market portfolio on trading day i relative to the announcement of the initial control bid, and OP is the price offered by the initial control bidder. P-values are in parenthesis. The sample is 6,100 initial control bids for public US targets, 1980-2008, with a complete set of control variables (defined in Table 5).

Dependent variable:	Target net runup $\frac{P_{-2}}{P_{-42}} - \frac{M_{-2}}{M_{-42}}$		Initial offer premium $\frac{OP}{P_{-42}} - 1$			
Intercept	0.116	0.282	0.616	1.073	0.494	0.778
	(0.000)	(0.012)	(0.000)	(0.000)	(0.000)	(0.000)
Target characteristics						
Target size	-0.015	-0.012	-0.054	-0.048	-0.039	-0.035
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
NYSE/Amex	0.007	0.003	0.017	0.011	0.010	0.008
	(0.330)	(0.650)	(0.239)	(0.442)	(0.422)	(0.529)
Turnover	0.000	0.000	-0.001	0.000	0.001	0.000
	(0.754)	(0.986)	(0.561)	(0.775)	(0.589)	(0.698)
$52 - week\ high$	-0.042	-0.029	-0.214	-0.175	-0.169	-0.146
	(0.000)	(0.018)	(0.000)	(0.000)	(0.000)	(0.000)
Bidder characteristics						
Acquirer public	0.032	0.032	0.046	0.052	0.012	0.018
	(0.000)	(0.000)	(0.001)	(0.000)	(0.305)	(0.136)
Horizontal	-0.015	-0.013	-0.009	-0.002	0.007	0.012
	(0.036)	(0.065)	(0.536)	(0.891)	(0.555)	(0.324)
Toehold size	-0.001	-0.002	-0.003	-0.004	-0.002	-0.002
	(0.002)	(0.000)	(0.000)	(0.000)	(0.014)	(0.004)
Stake bidder	0.050	0.056	-0.029	-0.012	-0.082	-0.072
	(0.043)	(0.024)	(0.560)	(0.804)	(0.051)	(0.088)
Stake other	0.125	0.126	0.089	0.093	-0.044	-0.040
	(0.000)	(0.000)	(0.100)	(0.084)	(0.340)	(0.382)
Deal characteristics						
Market runup			0.924	1.054	0.815	0.926
			(0.000)	(0.000)	(0.000)	(0.000)
Net runup					1.077	1.068
					(0.000)	(0.000)
Tender offer	0.037	0.028	0.094	0.076	0.055	0.046
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
All cash	-0.009	0.000	-0.024	-0.002	-0.014	-0.001
	(0.209)	(0.948)	(0.112)	(0.914)	(0.278)	(0.949)
All stock	0.003	0.000	-0.005	-0.008	-0.007	-0.008
	(0.725)	(0.976)	(0.755)	(0.631)	(0.600)	(0.578)
Hostile	-0.009	-0.011	-0.005	-0.008	0.005	-0.004
	(0.521)	(0.425)	(0.865)	(0.773)	(0.825)	(0.874)
Year fixed effects	no	yes	no	yes	no	yes
Adjusted R^2	0.025	0.038	0.077	0.092	0.339	0.346
$F - value$	13.1	6.86	37.4	15.7	209.2	76.0